ENVIRONMENTAL NOISE MANAGEMENT PROGRAM REPORT

Contract No. DACA51-96-D-0003
Delivery Order 08

Prepared for

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January 26, 1999

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LIST OF ACRONYMS AND ABBREVIATIONS

ADNL	Day-Night Average A-Weighted Sound Level
AFB	Air Force Base
AL	Armstrong Laboratory
APZ	Accident Potential Zone
AWSS	Area Weapons Scoring System
CDNL	Day-Night Average C-Weighted Sound Level
CZ	Clear Zone
dB	decibel
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EIR	Economic Impact Region
ENMP	Environmental Noise Management Plan
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
Fort Dix	Fort Dix Garrison
FY	Fiscal Year
HUD	U.S. Department of Housing and Urban Development
HE	high explosive
HMMWV	High-Mobility, Multi-Purpose Wheeled Vehicle
Hz	Hertz
LAW	Light Assault Weapon
LEQ	equivalent noise level
LITR	Low-Noise Training Round
MLRS	Multi-Launch Rocket System
NAEC	Naval Air Engineering Center
PD	proximity detecting
RAP	Rocket Assisted Projectile
SEL	Sound Exposure Level
TOW	Tube-launched, Optically Tracked, Wire-Guided
USA	United States Army
USAF	United States Air Force
USARC	United States Army Reserve Command
USEPA	United States Environmental Protection Agency
UTES	Unit Training Equipment Site

1.0 PURPOSE AND NEED FOR ACTION

1.1 Introduction

Ogden Environmental and Energy Services Co., Inc. (Ogden) was retained by the U.S. Army Corps of Engineers (USACE) to perform an Installation Compatible Use Zone (ICUZ) study for the Fort Dix Garrison located at Fort Dix, New Jersey (Figure 1-1). This work was conducted under Contract DACA51-D-96-0003, Delivery Order Number 08, Project Number EM-00020-7P.

The Directorate of Public Works at Fort Dix, New Jersey, has identified the need to update the May 1986 Fort Dix ICUZ study, due to changes in Fort Dix's mission and as required by the National Environmental Protection Act (NEPA) requirements. Changes in the number of personnel station on the base and changes to the type of training being conducted because of the current trend in Department of Defense reductions necessitated an update to the ICUZ study. The ICUZ study has been renamed by the Army under AR 200-1, Section 7, as the Environmental Noise Management Program.

1.2 Purpose and Need

The purpose of this Environmental Noise Management Program (ENMP) is to assess the impact of noise that may be produced by United States Army (U.S. Army) activities associated with current missions, to identify noise incompatible use zones within or surrounding the Fort Dix Garrison (Fort Dix), and to present recommendations to the installation Commander to mitigate unacceptable noise levels on installation noise-sensitive areas while protecting the installation's missions. This program is also designed to provide information to surrounding communities to help prevent the degradation of mission capability due to encroachment by noise-sensitive land uses. The ENMP requires that ENMP Report be updated when significant changes occur in noise sources or in intervals of no more than 5 years.

This study is an update of the May 1986 Fort Dix Installation Compatible Use Zone study. This update presents and documents changes to the noise environment on the installation for the period 1986 to 1998. It reaffirms the U.S. Army policy of protecting the public health and welfare of both the U.S. Army community and the public within, adjacent to, and surrounding U.S. Army installations from noise associated with military operations. The report presents changes in range operations since the last study. In addition, it provides current noise contours for flight and artillery activities and compatible use guidelines for land areas surrounding the reservation. It is hoped that this information will assist the local communities and serve as a tool for future planning and zoning activities.

The ENMP not only looks at current activities on the installation, but also considers the impacts of future weapons and missions. This program is designed to take into consideration both existing and projected conditions and the possibility of future impacts on the installation resulting from encroachment by surrounding communities. The ENMP process attempts to take immediate steps to prevent these land compatibility conflicts from occurring or at least minimize their impacts. This program is therefore designed to be preventive rather than reactive, a planning tool that should be updated on a regular basis (Appendix A).

The ENMP uses the latest technology to define noise levels in areas near U.S. Army installations, in addition to the collection of real time data from locations around the installation. An analysis of Fort Dix's range operations and other training areas was performed, which included the collection of the noise data for the following types of training activities: aircraft; artillery; small bore firing, which includes pistols, rifles, etc.; and convoy activities. This information was used to develop the noise contours contained in this study. Department of Defense (DOD) methodologies, MR_NMAP and MicroBNOISE, were used to define the noise zones for Fort Dix. MR_NMAP is a computer model that was used to generate noise contours from aircraft activities, and MicroBNOISE was used to generate noise contours from the artillery and demolition firing (Appendix B). The program MicroBNOISE was developed by the U.S. Army Construction Engineering Research Laboratory. The MR_NMAP was developed by Wyle

Laboratories. The databases used in both MicroBNOISE and MR_NMAP were developed using noise levels from actual noise events. Noise generated from small-bore firing and convoy activities was collected in the field and evaluated to determine empirical attenuation coefficients for the noise propagation.

1.3 Process and Procedure

Preparation and presentation of the Fort Dix ENMP is part of the continuing U.S. Army participation in the local planning process. It is recognized that, as local communities prepare land use plans and zoning ordinances, the U.S. Army has the responsibility to provide inputs on their activities relating to the community. This study is presented in the spirit of mutual cooperation and assistance by Fort Dix to aid in that planning process.

Data collection for range operations has been ongoing since July 1997. Potential existing noise sources onsite (or those sources suspected to be future noise contributors) were cataloged into a master list of test candidate areas. This list was then verified with Fort Dix personnel to ensure that it reflects a reasonable sampling of the noise environment at the post. In addition, areas from previous ENMP work were incorporated in this study. Noise contours and ENMP maps in this study are based on current mission plans.

2.0 INSTALLATION DESCRIPTION

2.1 Location

Fort Dix is located approximately in the center of New Jersey, 69 miles southwest of New York, NY; 16 miles southeast of Trenton, NJ; and 27 miles northeast of Philadelphia, PA. Fort Dix extends across the county line that separates Burlington County from Ocean County. Land uses adjacent to Fort Dix include McGuire Air Force Base (AFB), Lakehurst Naval Air Engineering Center (NAEC); Lebanon State Forest; Springfield Township, Wrightstown Borough, Pemberton Borough, and Pemberton Township (all located within Burlington County); and Plumsted Township, Jackson Township, and Manchester Township (all located within Ocean County) (Figure 2-1).

2.2 Mission

Fort Dix is a U.S. Army Reserve Command (USARC) training, mobilization and deployment center. Its primary mission is to provide training support to active and reserve component units of all services and licensed non-Department of Defense (DoD) activities. It also serves as a major power projection platform with the mission of receiving, training, equipping, and deploying military forces. As the largest U.S. Army installation in the New York Metropolitan/Delaware Valley Area, Fort Dix functions as a support base for contingency operations. Fort Dix also provides intra-area service support and services to off-post active and reserve component units, activities and individuals.

2.3 Economic Impact

Land uses in the area surrounding Fort Dix consist of residential housing, light industry, commercial business, and agricultural lands. The area has seen continuous growth in business, urban, and suburban development. Significant sectors within the area's economy include services, trade and manufacturing, state and local government, military, and agriculture. Fort

Figure 2-1

Dix is served by Philadelphia International Airport, Newark International Airport, several municipal airports, Interstate 295, the New Jersey Turnpike, and United States Highway 206.

The 1990 Census measured Burlington County's population at 395,066. Adjacent Ocean County reported a population of 433,203. In 1992, the populations for Burlington and Ocean Counties had increased to 397,631 and 438,315, respectively. Census information for 1995 indicated that the populations for the two counties are approximately 403,337 and 464,822, respectively. Population figures for individual townships and communities in the study area are presented in Table 2-1.

Table 2-1. Township and Community Populations

Affected Jurisdiction	Population
Burlington County	
Springfield Township	3,028
Wrightstown Borough	3,843
Pemberton Borough	1,367
Pemberton Township	31,342
New Hanover Township	9,564
Ocean County	
Plumsted Township	6,005
Jackson Township	33,233
Manchester Township	35,976

Source: United States Department of Commerce, Bureau of the Census. 1990 Census of Population and Housing

McGuire AFB, Lakehurst NAEC, and Fort Dix are the major military installations in the area and play a prominent role in the regional economy. Fort Dix's economic impact region (EIR) is the geographic area subject to significant base-generated economic impacts and is defined as the area within a 40-mile radius of the base. The military and civilian personnel assigned to these installations have a significant impact on the surrounding communities due to a large federal payroll and a high volume of local purchases.

The base employs approximately 1,061 permanent part-active-duty military personnel, as well as 3,019 Reserve and National Guard personnel. In addition, Fort Dix employs 2,319 full-time appropriated and non-appropriated funded civilian personnel, which includes tenant organizations. Approximately 25,000 military retirees from the Delaware Valley area also utilize base services. Fort Dix provides training services to approximately 82,210 off-post personnel within a 40-mile radius (which includes all military services). Fort Dix also provides residential housing to military personnel and their families, which includes approximately 2,100 people. In addition to direct participation in the local economy, Fort Dix personnel support such community activities as scouts, church activities, sports, and charity fund raising.

The total gross payroll distributed to employees at Fort Dix in fiscal year (FY) 1996 was approximately $107.3 million. Of this amount, $37.8 million in appropriated funds was paid to civilian employees. Total non-appropriated funds disbursed to contract civilians and private business were approximately $29.7 million. Military personnel received appropriated funds totaling $39.8 million.

2.4 Noise Assessment Criteria

According to AR 200-1, the objectives of noise abatement are to assess the environmental impacts from noise produced by military activities and mitigate harmful or objectionable effects to the maximum extent possible; to comply with applicable Federal, state, interstate, and local standards pertaining to noise consistent with military requirements; to achieve noise abatement through the application of engineering noise control measures, modern land use planning, and procurement of low-noise emission products; and to incorporate noise control provisions as necessary. As part of the Noise Assessment Criteria, three noise zones have been developed by the Army to categorize the levels of noise produced by a certain activity. These noise zones will be used to identify potential conflicts with existing land uses. The three noise zones are presented in Table 2-2.

Table 2-2. Noise Limits

Noise Zone	Population Highly Annoyed	Transportation ADNL	Impulsive CDNL	Small Arms ADNL
Zone I	**<15%**	**<65 dBA**	**<62 dBC**	**<87 dBP**
Zone II	**15%-39%**	**65-75 dBA**	**63-70 dBC**	**87-104 dBP**
Zone III	**>39%**	**>75 dBA**	**>70 dBC**	**>104 dBP**

Notes:
dBA - decibels, A-weighted
dBC - decibels, C-weighted
dBP - decibels, unweighted

Acceptable noise-sensitive land uses such as housing, schools, and medical facilities are compatible with the noise environment in Zone I, normally compatible in Zone II, and incompatible in Zone III.

2.5 Flying Activity

Two distinct types of noise may result from aircraft operations. When aircraft fly slower than the speed of sound, or subsonically, noise is produced by the aircraft's engine and by effects of aircraft movement through air (airframe, rotors, propellers). When an aircraft flies faster than the speed of sound, a sharply defined shock front is created, producing a distinct characteristic called overpressure, the physical cause of a sonic boom. Helicopters, twin engine props, and C-130s are the only aircraft flown at Fort Dix, and these aircraft do not achieve supersonic speeds; only subsonic aircraft noise is addressed in this document.

2.5.1 Subsonic Noise

The physical characteristics of noise, or sound, include its intensity, frequency, and duration. Sound is created by acoustic energy, which produces pressure waves that travel through a medium such as air or water and are sensed by the eardrum. This may be likened to ripples in water that would be produced when a stone is dropped into it. As acoustic energy increases, the intensity or height of these pressure waves increases, and the ear senses louder noise. The human ear is capable of responding to an enormous range of sound levels, from that of a soft whisper to a rocket engine. In generic terms, if the faintest sound level we can recognize (threshold of hearing) were assigned a value of one, on the same scale, the highest level we are capable of hearing (threshold of pain) would be assigned a value of 10 million. To make this large range of values more meaningful, an adaptation of a logarithmic mathematical scale is used (i.e., the decibel [dB] scale). On the dB scale, the range of human hearing is represented at the lowest audible level by 20 dB and the maximum level, or threshold of pain, at approximately 140 dB.

Low frequency sounds are heard as "rumbles," and high frequency sounds are heard as "screeches." Sound measurement is further refined by "weighting." The normal human ear can detect sounds that range in frequency from about 20 cycles per second (Hz) to 15,000 Hz. However, all sounds throughout this range are not heard equally well. Therefore, some sound meters are calibrated to emphasize frequencies in the 1,000- to 4,000-Hz range. The human ear is most sensitive to frequencies in this range, and sounds measured with these instruments are termed "A-weighted." The duration of a noise event and the number of times noise events occur are also important considerations in assessing noise impacts.

Sound is measured with instruments that record instantaneous sound levels in dB. With these measurements, sound levels for individual noise events and average sound levels, in dB, over extended periods of hours, days, months, or years can be calculated (e.g., the Daily Day-Night Average Sound Level [DNL] in dB).

2.5.2 Sound Exposure Level

The sound exposure level (SEL) measurement provides a means of describing a single noise event such as an aircraft overflight comprising a period of time when an aircraft is approaching and noise levels are increasing, an instant when the aircraft is directly overhead and the maximum noise level is experienced, and the period of time when the aircraft moves away from the receptor resulting in decreased noise levels. SEL is a measure of the physical energy of a noise event, which takes into account both intensity (loudness) and duration. Appendix B provides a brief comparison of A-weighted, SEL values for military aircraft operating at various altitudes and power settings.

2.5.3 Day-Night Average Sound Level

The day-night average sound level (DNL) is the energy-averaged sound level measured over a 24-hour period, with a 10-dB penalty assigned to noise events occurring between 10:00 p.m. and 7:00 a.m. The 10-dB penalty is intended to compensate for generally lower background noise levels and increased annoyance associated with noise events occurring between the hours of 10:00 p.m. and 7:00 a.m. DNL values are obtained by summation and averaging of SEL values for a given 24-hour period. DNL is the preferred noise metric of the United States Department of Housing and Urban Development (HUD), FAA, USEPA, and DoD.

People are constantly exposed to noise. A person in a wilderness area may be standing along a fast-flowing river and exposed to measured noise levels of 70 dBA or higher; a normal conversation at 3 feet measures approximately 60 dBA. Most people are exposed to sound levels of 50 to 55 DNL or higher on a daily basis. Studies specifically conducted to determine noise impacts on various human activities show that about 90 percent of the population is not significantly bothered by outdoor sound levels below 65 DNL.

Although DNL does provide a single measure of overall noise impact, it does not provide specific information on the number of noise events or specific individual sound levels that occur.

For example, a DNL of 65 dB could result from very few, but very loud events or from a large number of quieter events. Although it does not represent the sound level heard at any one particular time, it does represent total sound exposure. Scientific studies and social surveys have found DNL to be the best measure to assess levels of annoyance associated with all types of environmental noise. Therefore, its use is endorsed by the scientific community and governmental agencies, such as USEPA, the Federal Interagency Committee on Urban Noise, and the Federal Interagency Committee on Noise.

2.5.4 Onset-Rate Adjusted Day-Night Average Sound Level

Aircraft operating at low-altitude and in special-use airspace generate noise levels different from other community noise environments. Overflights can be sporadic, which differs from most community environments where noise tends to be continuous or patterned.

Military overflight events also differ from typical community noise events because of the low-altitude characteristics of military aircraft. These characteristics result in aircraft that exhibit a rate of increase in sound level (onset rate) of up to 30 dB per second. To account for the random and often sporadic nature of military flight activities, computer programs calculate noise levels created by these activities based on a monthly, rather than a daily, period. The adjusted DNL is designated as onset-rate adjusted monthly day-night average sound level (L_{dnmr}).

2.5.5 Ambient Noise

Ambient noise can vary considerably depending on location and other factors, such as wind speed. In addition, it is reasonable to assume that ambient background noise at Fort Dix would have little or no effect on the calculated noise levels because the ambient levels would add insignificant fractions to calculated values. Therefore, ambient background noise is not considered in the noise calculations.

2.5.6 Aviation

To describe the relationship between aircraft operations and land use, it is necessary to fully evaluate the exact nature of flying activities. An inventory has been made of information such as the types of aircraft utilizing Fort Dix, where those aircraft fly, how high they fly, how many times they fly over a given area, and at what time of day they operate.

Data collection was conducted at Fort Dix in July 1997. Aircraft data were obtained to derive average daily operations, by activity and type of aircraft. Data are supplemented by flight track information (where they fly) and flight profile information (how they fly). After verification for accuracy, data were input into the DoD MR_NMAP software program and converted into L_{dnmr} noise contours.

No aircraft are permanently assigned to Fort Dix. The Fort Dix Aviation Detachment provides base operations support services (flight planning, fuel, ramp support, range briefings) to aviation units assigned to the U.S. Active Army, U.S. Army Reserve, the U.S. Army National Guard, and the Coast Guard. Helicopter aviation units across the northeastern United States utilize aviation support functions at Fort Dix in addition to Area Weapons Scoring System (AWSS) ranges for aerial gunnery training. During both weekend training events and annual training events (lasting as long as two weeks), aircraft involved in training activities are based out of the Fort Dix Flight Detachment.

Many types of transient helicopters receive service from the Flight Detachment. Transient aircraft typically do not participate in range-related activities, often stopping only for refueling or rest. The primary aircraft using the range facilities include UH-1, AH-1, and, to a lesser extent, UH-60, RH-64 and CH-47 helicopters. The RH-64 attack helicopter will replace the AH-1 attack helicopter in the future, as the military units retire the AH-1 and replace it with the RH-64 helicopters.

Helicopters using the Fort Dix range facilities often initiate a training event from the Flight Detachment ramp, proceeding out to designated landing areas, gunnery ranges, or mock airfields. During training events, aircraft shuttle to and from the mock air base and ranges in order to fulfill personnel flight and aerial gunnery training requirements. Although only eight to ten aircraft may take part in an exercise, many pilots, copilots, and gunners achieve training requirements by conducting many individual flights. Each flight (often referred to as a sortie) is made up of a takeoff, landing, and at least one interim training event. Each of these activities is considered an operation. One flight consists of a minimum of two operations, a takeoff and a landing. The noise levels generated as a result of the current flying activity for the 1997 calendar year (listed in Table 2-3) are presented in Figure 2-2. The RH-64 was not included in the noise modeling at this time. The RH-64 will be incorporated into future ENMP Reports once the RH-64 helicopter training activities begin at Fort Dix.

Table 2-3. Military Aircraft Operations

Type of Aircraft	Typical Activity	Estimated Annual Operations
UH-1 (Huey)	Transient, IDT, AT	354
AH-1 (Cobra)	Transient, IDT, AT	103
UH-60 (Black Hawk)	Transient, IDT	30
SK-76 (Eagle)	Transient, IDT	2
CH-47 (Chinook)	Transient	7
CH-53 (Stallion)	Transient	2
OH-58 (Kiowa)	Transient	2

Note: Operations imply one takeoff, one landing, or a portion of a single aircraft sortie.
IDT = Individual Training
AT = Annual Training

As noted in Figure 2-2, noise levels tend to be higher in Range 61 (maximum of 69 L_{dnmr}) than in either Range 85 or the mock air base, each having noise levels ranging from 50 to 60 L_{dnmr}. The Fort Dix general flying area has the lowest noise levels of the areas considered, with the majority of the area exposed to noise levels below 50 L_{dnmr}. Range 61 is the primary aerial gunnery range, hosting about 95% of aircraft-related training.

Figure 2-2

None of the noise levels generated in the areas considered causes noise exceeding 65 L_{dnmr} to extend beyond Fort Dix boundaries.

Flight tracks followed by aircraft result from several considerations, including:

- Takeoff patterns routed to avoid heavily populated areas as much as possible
- Criteria governing the speed and rate of climb for each type of aircraft
- Efforts to control and schedule missions to keep noise levels low, especially at night
- Coordination with the Federal Aviation Administration (FAA) and McGuire AFB to minimize conflict with civilian and military fixed-wing aircraft operations.

Federal Aviation Regulations (FARs) establish controlled airspace. Controlled airspace is a generic term that covers the different classification of airspace and defined dimensions within which air traffic control services are provided. In the case of Fort Dix, all helicopter activity conducted at the Flight Detachment ramp is coordinated with air traffic control personnel at McGuire AFB. Further flight information such as local procedures, safety, and range coordination are contained in Fort Dix Aviation Regulation 95-1. U.S. Army Aviation activities at McGuire AFB are addressed in McGuire AFB Instruction 11-201.

Efforts are continually made to control and schedule missions to keep noise levels to an absolute minimum, especially at night. Pilot awareness of public needs is provided through flying safety training and standardization meetings.

Airfield environs planning is concerned with three primary aircraft operational/land use determinants: (1) safety, (2) aircraft noise, and (3) hazards to operations from land uses (e.g., height obstructions). Each of these concerns is addressed in conjunction with mission requirements and safe aircraft operation to determine the optimum flight activities for each aircraft type.

2.6 Range Methodology

The noise environment produced during Army training activities is characterized by two types of noise. Vehicles produce noise that are best described in terms of A-weighted day night level (ADNL). A-weighting measures the high frequency noise, which closely resembles the frequency response of human hearing and, therefore, provides a good indication of the impact produced from transportation activities. The second type of noise, high amplitude, is produced from the armor, artillery and demolition firing, which is best described in terms of C-weighted day night level (CDNL). C-weighting measures the low frequency component of noise, which can cause buildings and windows to shake and rattle.

As part of the field activities for the ENMP, Ogden personnel conducted noise sampling activities July 11 to 15, 1997. Sound levels were measured at various locations on Fort Dix using five Larson Davis 700 ANSI Type 2 integrating sound level meters. The sound meters were position at various locations to record noise levels for a 24-hour period. Tables 2-4 and 2-5 present the 24-hour noise monitoring results for the Range Area and the Cantonment Area, respectively. Information contained in Tables 2-4 and 2-5 includes the location of the monitoring station, geographical coordinates, and the noise data averaged over a 24-hour period. The noise data is presented as L_{eq}, L_{max}, L_{min}, L_{10}, L_{50}, L_{90} and L_{99}. The following presents a description of the noise metrics included in the tables. The L_{eq} corresponds to the equivalent noise level recorded. The L_{max} represents the maximum sound level recorded and the L_{min} represents the lowest sound level recorded over the 24-hour monitoring period. The values for L_{10}, L_{50}, L_{90} and L_{99} correspond to noise levels that would be heard 10, 50, 90 or 99 percent of the time during the 24-hour monitoring period.

Specific data was collected for the small arms ranges; however, due to scheduling conflicts, the artillery and tank firing and the demolition firing were not able to be recorded. Noise information regarding these activities was modeled using noise data provided by the MicroBNOISE computer program.

2.6.1 Small Arms Ranges

Small arms ranges are treated more as continuous noise sources due to the constant firing when in use. Although a single shot is an impulsive noise, when presented with hundreds of rounds being fired, the noise merges into a very distinct continuous sound.

2.6.1.1 Types of Noise

Small arms come in a wide range of calibers. For the military, the most common small arms are the M-16 rifle (5.56 mm), the M-60 machine gun (7.62 mm), the 9 mm/.45 caliber pistol, and the .50 caliber machine gun. These weapons differ in three ways:

- Muzzle blast
- Speed of the bullet
- Rate of fire.

Muzzle Blast

The sound pressure level of a muzzle blast depends on the amount of propellant and the length of the gun tube or barrel. A given amount of propellant will make more noise fired from a pistol than from a rifle. In the pistol, the expanding gas of the bullet leaves the barrel sooner than in a rifle because the pistol barrel is shorter. In the rifle, the expanding gas transfers more of its energy to the bullet than in a pistol. With more energy transferred to the bullet, there is less energy in the sound wave.

Speed of the Bullet

The bullet for a rifle travels faster than the bullet from a pistol. Bullets traveling faster than 1,100 feet per second are faster than the speed of sound; most military rifle bullets travel at

Table 2-4. Fort Dix 24-Hour Noise Monitoring Results, Range Area

Monitoring Location	GPS Lat (DMS N)	GPS Long (DMS W)	24 Hour Noise Metrics in dBA						
			Leq	Lmax	Lmin	L10	L50	L90	L99
Mid State Correctional Facility	39 59 48	74 35 02	49.1	60.0	41.0	51.0	45.5	42.0	41.0
Lake of the Woods	39 59 29	74 34 24	43.5	57.0	40.5	48.0	42.0	40.5	40.5
Intersection Range Road / E. Lakeshore Rd	39 59 30	74 33 52	67.1	75.5	47.0	71.5	62.0	53.5	48.0
Range Control	39 59 33	74 32 46	46.9	53.0	45.5	48.5	46.0	45.5	45.5
Range 19 Area	39 59 12	74 32 32	63.3	75.0	45.0	67.0	48.0	46.0	45.5
Hanover Furnace Entrance	39 58 55	74 31 36	41.6	65.5	38.0	44.5	39.0	38.5	38.5
Range 29 Area	39 58 51	74 30 14	41.5	49.0	37.5	42.5	40.5	38.5	37.5
Range 34 Area	39 58 40	74 28 17	43.2	53.0	37.0	47.0	39.5	37.0	37.0
Times Square	39 59 02	74 25 38	43.8	50.0	40.0	46.0	42.5	40.5	40.0
Mock Airbase	39 57 47	74 25 41	48.9	54.0	42.5	51.0	48.5	44.0	43.0
UTS 1	39 57 03	74 24 26	40.9	47.0	39.0	42.5	40.0	39.5	39.0
AFP 14	39 59 31	74 25 29	45.4	50.5	43.5	47.0	44.5	44.0	43.5
Bomarc Area	40 02 14	74 26 19	42.3	49.5	40.0	44.0	41.0	40.0	40.0
Range 85 Area	40 02 25	74 27 55	44.1	52.0	40.0	47.0	42.0	40.5	40.0
Range 59C Area	40 00 42	74 27 24	47.5	55.0	44.5	49.0	46.0	46.0	45.5
Range 14 Area	40 00 00	74 33 09	53.1	60.5	42.5	57.0	50.5	44.5	42.5
Range 6	40 01 27	74 32 49	48.4	56.5	44.0	50.0	45.5	44.5	44.0
NE of Taylor Mountain	40 02 12	74 32 49	44.3	51.0	43.0	45.0	43.5	43.0	43.0
Brindle Lake	40 02 08	74 30 32	46.6	56.0	41.0	46.0	42.0	41.5	41.0
Pole Line Rd & Jacks Run	40 00 45	74 34 16	47.7	57.0	44.5	49.0	46.5	45.5	45.0

Table 2-5. Fort Dix 24-Hour Noise Monitoring Results, Cantonment Area

Monitoring Location	GPS Lat (DMS N)	GPS Long (DMS W)	24 Hour Noise Metrics in dBA						
			Leq	Lmax	Lmin	L10	L50	L90	L99
Fire Station #2	40 00 40	74 37 21	68.1	78.5	53.0	73.0	64.5	57.5	56.0
Holly Crest	40 00 33	74 37 59	51.0	57.5	47.0	53.0	49.5	48.0	47.5
Federal Prison	39 59 55	74 37 24	62.5	72.5	54.0	65.5	56.5	55.0	54.5
Ft. Dix Elementary	39 59 39	74 37 40	60.2	62.5	56.5	61.5	60.0	57.0	57.0
Burger King	40 01 39	74 37 04	70.7	78.0	55.5	76.5	62.0	58.5	56.5
Golf Course	40 01 18	74 37 51	60.2	71.5	48.0	63.5	53.0	49.5	48.5
Garden Terrace Housing	39 59 53	74 38 30	46.1	50.0	44.0	47.5	45.5	44.5	44.0
5900 Water Tank	40 00 03	74 37 25	48.9	52.5	47.0	50.0	48.5	47.0	47.0
Walson Airforce Hospital	40 00 49	74 37 39	52.1	60.5	48.0	53.0	51.0	49.0	48.0
Pennsylvania Ave & Sever Ave	40 01 02	74 37 16	61.3	75.0	47.5	62.0	49.0	48.0	48.0
Alabama Ave & Parade Grounds	40 00 50	74 37 02	60.3	69.5	47.0	66.0	50.5	47.5	47.0
Boiler Plant	40 00 56	74 36 57	48.1	54.5	45.0	52.0	46.0	45.5	45.0
Alabama Ave & Texas St	40 01 16	74 36 48	56.8	64.0	48.5	60.0	55.5	50.0	49.0
Argonne Rd @ Area 41	40 02 08	74 37 33	59.9	68.0	45.0	65.5	54.0	46.0	45.5
Army Reserve Center	40 01 25	74 38 21	59.8	69.0	47.5	64.5	53.0	48.0	48.0
DPW	40 01 18	74 37 08	60.6	71.5	54.0	63.5	57.0	54.5	54.0
Wastewater Treatment Plant	40 01 04	74 36 33	57.1	66.0	55.5	57.0	56.0	55.5	55.5

supersonic speeds, whereas the .45 caliber pistol is subsonic. Supersonic bullets generate a ballistic wave along their path, and the size of the ballistic wave depends more on the caliber of the bullet than the speed. Table 2-6 lists the bullet speeds of four common small arms.

Table 2-6. Bullet Speed in Five Common Small Arms

Size	Ammunition	Feet/Second
5.56 mm	Ball, M193	3,250
7.62 mm	Ball, M80	2,750
9 mm pistol	Ball	855
.45 caliber pistol	Ball	885
.50 caliber machine gun	Ball, M2	2,700

Rate of Fire

Small arms are fired at different rates. Machine guns are fired in bursts, whereas rifles are fired as bursts or single shots. The pistols are always fired as a single shot.

The rate of fire is important because of the effects on the equivalent noise level (LEQ). LEQ (the measure used in environmental noise assessments) gives equal weight to the dB level and the number of noise events. People living near small arms ranges do not always hear the shots as separate events. In addition to the merging of single shots during bursts of firing, several soldiers may fire at the same time. Although the soldiers are striving for accuracy, they are trying to qualify under timed conditions. As a result, people living near a military rifle range hear short periods of intense firing followed by longer periods of silence as soldiers check their targets and perform weapons maintenance. Under these conditions, the number of shots becomes less important than the dB level of the typical (average) shot.

2.6.1.2 Noise Levels

Small arms release the most noise from the muzzle and the least noise from the receiver. "A-weighting" adjusts the sound level meter input for the sensitivity of the human ear. A-weighted sound levels have been found to have excellent correlation with human annoyance from those sounds. Examples of such noise sources at Fort Dix would be tracked vehicles, helicopters, trucks, and small arms ranges. Several types of small arms are fired on the ranges at Fort Dix. Table 2-7 lists the small arms used at Fort Dix.

As shown in Table 2-3, noise levels recorded over a 24-hour period for various locations within the Range Area, showed that the L90 noise levels were below the 65 dBA level (Zone I). The L90 noise level is defined as, for 90% of the time the noise levels would be heard at this level. Noise data collected from the firing ranges located along range road was contoured and illustrated on Figure 2-2. Based on the data collected, noise levels above 60 dBA, for the firing ranges, are not extending past Range Road.

2.6.2 Artillery Ranges

2.6.2.1 Indirect Fire Weapons

Indirect fire weapons are a sporadic noise source. Each firing is a distinct sound but unlike small arms ranges, the frequency of firing is not consistent. Nevertheless, the intermittent firing has a cumulative effect on annoyance of humans.

2.6.2.2 Types of Noise

The U.S. Army employs three kinds of indirect fire weapons: mortars, howitzers, and the Multi-Launch Rocket System (MLRS). In contrast to direct fire weapons, such as tank cannon and small arms, the person firing an indirect fire weapon never sees the target. Instead, a forward observer watches the target and radios adjustments to the soldiers at the firing point.

Table 2-7. Listing of Small Arms

WEAPON TYPE BY CALIBER	RANGE NUMBERS
22 Cal Rim Fire (M-16)	1, 6, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 34, 37, 39A, 35, 38, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
.38 Cal	1, 6, 6A, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 37, 39A, 38, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
.357	1, 6, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
.45 Cal	1, 6, 6A, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
9mm	1, 6, 6A, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
10mm	1, 6, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 31, 33, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
5.56mm (M16)	1, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 30B, 31, 32, 33, 34, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
7.62mm (M14)	1, 11, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 27A, 27B, 27C, 28, 29, 30A, 32, 33, 34, 35, 37, 38, 39A, 47A, 53, 59C, 59D, 61, 63, 65, 71, 85.
7.62mm (M60)	1, 7, 10, 11, 15, 30A, 32, 33, 47A, 59C, 59D, 59E, 61, 63, 65, 85.
.50 Cal (M2)	1, 7, 10, 11, 15, 47A, 53, 59C, 59D, 61, 63, 65, 85.
M72A2 Law	59C.
40mm Grenade Launcher	1, 7, 8, 9, - TP, 30A, 59C - TP, HE and ILL, 59D - TP and ILL.
35mm Law Sub Cal	1, 7, 8, 59C, 59D, 65.
M249 SAW	1, 10, 11, 30A, 30B, 47A, 59C, 59D, 61, 63, 65, 71.
Shotgun	Ranges 1, 8, 10, 13, 14, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 34, 37, 39A, 53, 59C, 61, 63, 65, 71.
Sub-Machinegun .45 Cal/9mm	1, 27A, 27B, 27C, 28, 29, 30A, 31, 33, 37, 53, 59C,

WEAPON TYPE BY CALIBER	RANGE NUMBERS
	65.
Demolitions	55, 59C, EOD.
66mm Heat Rocket	59C.
M18A1 Claymore Mine	59C.
Tank Sub-Cal, 105mm TP-T, 120mm TP-T, 120mm TPCSDS-T	47A, 61, 65, 85 All weapons.
7.62 Mini Gun	61, 65, 85.
60 mm Mortar	1, 39, 39A, 59C, 47 – TP, 61, 65, 85 – Illumination, MFP 2, 3, 4, 6 - Service.
81 mm Mortar	1, 39, 39A, 59C, 71, 75 - Service.
120mm Mortar	1, 61, 65, 85 - TP.
Artillery	59C.
Hand Grenade	3A - Fragmentation, Concussion, Smoke.
AT4	1, 7, 8, 59C - Service, 59D, 61, 65, 85 - Subcaliber.

Mortars are generally smaller, lighter, and have less range than howitzers. In contrast, howitzers have far greater range and are either self-propelled, towed, or airlifted into position.

Mortars

A mortar looks like a large diameter pipe pointed upward at an angle. To fire a mortar, a soldier drops a round down the tube. When the round hits the base of the tube, the primer strikes the firing pin, and the round goes out the way it entered. Hearing protection is essential, because the soldier is so close to the muzzle blast. A mortar round comes with enough propellant for the maximum range. For a lesser range, some of the propellant is taken out of the round. U.S. Armed Forces have used three mortars, and a fourth is expected to be fielded in the future.

- 60 mm mortar - This small man-portable weapon is used primarily by light infantry forces. Maximum range exceeds 3,400 meters, and the high explosive (HE) round has only 0.4 lb. of explosive.
- 81 mm mortar - The maximum range of the 81 mm mortar is less than 5 kilometers. The HE round has 2.25 lb. of explosive.
- 120 mm mortar – Replaces the 107mm or 4.2-in heavy mortar system and has a range of approximately 7,240 meters. The HE round contains 8.5 lb. of explosive.

Howitzers

The noise database for the software used to generate firing range noise contours, MicroBNOISE, gives the user a choice of 105mm, 155mm and 8-inch (203mm) howitzers. In practice, most artillery training uses the 155mm howitzer. The 155mm howitzer comes in two basic designs: the M109A1, which is driven to the firing point, and the M198, which can be carried to the firing point by a helicopter. In either case, the 155mm howitzer is a powerful weapon, and the soldiers in the battery must stand some distance from the muzzle and fire with a lanyard.

In firing a howitzer, the crew first loads enough propellant to reach the target zone and then carries out a finer adjustment within that zone by elevating or lowering the angle of the gun tube. For closer targets, the crew uses a propellant series known as Green Bag. For farther targets, they use a propellant series known as White Bag. For the farthest targets (in excess of 15 kilometers), they use a Rocket Assisted Projectile (RAP round). When using a Green or White Bag charge, the crew uses only the number of bags needed for the target zone. For minimum range targets, the crew only uses Zone 3 Green Bag. The other bags in the Green Bag series are set aside for later disposal.

Unlike the tank cannon and small arms discussed in earlier sections, the 155 mm howitzer has a muzzle brake. The purpose of the muzzle brake is to reduce the recoil. The brake accomplishes this by deflecting some of the propellant gas backward. This balances out the forces on the gun tube and makes it easier to keep the tube stable. The acoustical effect is to change the pattern of the unmuzzled gun by reducing the noise in front and increasing the noise to the rear.

Types of Rounds

Mortars and howitzers can be used to fire smoke rounds to create cover on the battlefield, illumination rounds to illuminate targets at night, white phosphorus rounds to start fires, and high explosive rounds to destroy the target.

For purposes of community noise, the only round that is heard when it hits the target is the HE round. The 155mm HE round contains about 15 lb. of explosive. When used with a proximity detecting (PD) fuse, the explosion occurs at ground level, and the noise generated is no different than from a 15-lb open air charge. The HE round of a howitzer or a mortar explodes in the open air, either near the ground of at a height above the target area. The magnitude of the sound is proportional to the single event explosive charge. The propagation of the acoustic wave is outward from the sound and is strongly influenced by weather conditions. The procedure for predicting the peak sound pressure level of military explosives is based on estimates on the equations for the noise level of one pound of TNT at various distances and under various weather

conditions. To get the level for a particular combination of explosives, an adjustment is added for the equivalent weight and for depth of burial.

More complaints are generated from HE rounds fired from mortars and howitzers and exploding in the impact area than from the noise generated at the mortar/howitzer firing point. For the 155mm howitzer, it is possible to substitute a low-noise training round (known as the LITR) for the HE round. Designed so that it generates a flash of light and a puff of smoke comparable to that of a true HE round, the LITR round is used in areas of high noise sensitivity.

The ballistic wave is not a significant noise source for mortars and howitzers. The higher zone charges on the 155mm howitzer leave the gun tube at supersonic speed, but the speed soon becomes subsonic. At apogee (the highest point in the ballistic trajectory), the speed is zero, and it then increases as the charge moves toward the target.

2.6.2.3Noise Levels

Average levels for the 81mm mortar, 120mm mortar, and M109A1 155 mm howitzer are listed in Table 2-8. The data shown are averages of all the measurements taken by Schomer et al. (1979). Behind the 155mm howitzer, the levels ranged from 101.5 dB with Zone 3 Green Bag to 108.9 with Zone 5 White Bag.

Table 2-8. C-Weighted SEL at 250 Meters: Mortars and Howitzers

Caliber/Charge Size	Degrees Azimuth from Direction of Fire						
	0	30	60	90	120	150	180
Mortar 81 mm/ Avg. Chg.	102.2	100.3	98.4	99.6	96.1	96.8	93.9
Mortar 120 mm/ Avg. Chg.	105.6	103.8	102.0	102.4	99.1	98.8	97.2
M109A1 155 mm/ Avg. Chg.	107.8	107.7	108.2	109.2	110.6	109.2	109.7

2.6.3 Rockets and Missiles

Rockets and missiles have two noise impact areas, the firing point and the impact point. Both are much like the noise from explosions although the firing point has a noise pattern related to the direction that the rocket exhaust is pointing. Fort Dix utilizes two types of rockets during training activities, the TOW (inert) and the 2.75-inch rocket (inert).

2.6.3.1 Types of Noise

A common feature of rockets and missiles is that the propellant noise is highest to the rear. Combat forces use rockets in five configurations: direct fire at ground targets from a ground position, indirect fire at ground targets from a ground position, direct fire at an aircraft from a ground position (anti-aircraft), direct fire at a ground target from an aircraft, and direct fire at an aircraft from an aircraft. Each of these situations presents a unique acoustical environment.

Direct fire at ground targets from a ground position

Ground forces employ several rockets against armored targets, such as tanks and infantry fighting vehicles. The smallest of these is the Light Assault Weapon (LAW) rocket, which is fired by a standing soldier who has the rocket tube resting on his shoulder. More effective against armor are the Dragon antitank rocket and the AT4. The most effective against armored targets is the

TOW (Tube-launched, Optically tracked, Wire-guided) missile. This weapon is carried on a High-Mobility, Multi-Purpose Wheeled Vehicle (HMMWV) or some other small tactical vehicle.

Indirect fire at ground targets from a ground position

The Multi-Launch Rocket System (MLRS) can fire one or more rockets against distant armored targets. The MLRS is designed to destroy targets in an area several hundred meters across. Because of the long range of the MLRS, the actual rounds can only be fired at large installations, such as White Sands Missile Range. In order to train at smaller installations, the U.S. Army developed a special short-range training round. Both the real and training rounds leave the rocket tube at supersonic speeds. For this reason, the ballistic wave must be taken into consideration when assessing noise generated by the MLRS.

Direct fire at an aircraft from a ground position (Anti-aircraft)

The primary anti-aircraft weapons for ground forces are the shoulder-fired Stinger missile, the vehicle-mounted Stinger system (Avenger), the vehicle-mounted Chaparral, the Patriot system, and the Hawk. Training with the Hawk, a ground-based missile that engages aircraft at relatively high altitudes, takes place only at Fort Bliss, and is not assessed in this document. Other anti-aircraft weapons are fired so far from the installation boundary as not to be a noticeable noise source.

Direct fire at a ground target from an aircraft

U.S. Army helicopters fire 2.75-inch and 3.5-inch rockets at ground targets. The largest weapon, the Hellfire missile, is so expensive that helicopter pilots use computer-controlled simulators to train.

2.6.3.2 Noise Levels

Table 2-9 lists the C-weighted SEL at 250 meters from some of the U.S. Army's rockets.

Table 2-9. C-Weighted SEL at 250 Meters: U.S. Army Rockets

Type of Rocket	Degrees Azimuth from Direction of Fire						
	0	30	60	90	120	150	180
LAW	88.3	89.7	90.8	98.8	101.4	104.9	106.8
TOW	84.1	86.4	87.9	99.7	102.6	104.7	106.1
2.75-inch Rocket	88.7	88.7	88.7	88.7	88.7	88.7	88.7

Source: Schomer, 1982; CHPPM, 1995.

3.0 LAND USE COMPATIBILITY

3.1 Introduction

Land use patterns at Fort Dix reflect the evolving missions of that installation over many years. Changes in land use occur when a particular arrangement is altered due to such factors as changes in the installation's mission or a change in weapons technology. A critical factor in planning or changing land use is the extent to which adjacent land uses are compatible with the projected land use and how these changes may conform to established policies of the Department of the Army.

3.2 Existing Conditions

The primary land use at Fort Dix is field training space. Training space is subdivided into maneuver and impact areas. Maneuver areas accommodate nearly all types of ground activity or aircraft overflight. Included in maneuver areas are paved areas established to train vehicle drivers in proper military convoy and motor vehicle operating techniques. In addition, specialized and support facilities are located in maneuver areas. Some examples of these are the correctional facility located on Range Road, the ammunition storage areas, and the Unit Training Equipment Site (UTES). Impact areas comprise sections of land that ordinance and small arms are fired into or exploded upon. Table 3-1 details, by site, the capabilities and conflicts associated with each of the firing ranges surrounding Fort Dix.

The Cantonment Area at Fort Dix contains activities such as family and unaccompanied-personal housing, troop billeting, administrative buildings, recreational areas, hospitals and health clinics, schools and classrooms, dining facilities, and utility operations. In addition, some installation land is granted to the general public, provided there is no conflict with military operations. The main uses available to the public are hunting, fishing, and hiking.

Table 3-1. Range Capabilities and Conflicts

SITE	LOCATION	TYPE OF SITE	AMMUNITION	# OF LANES/ DEMOLITION AREA	REMARKS
RG 1	WV407301	Test Range: Ordnance testing and experimental range.	All small arms, all mortars, 40mm TPT, 20mm TPT, 2.75 RKT, 35mm sub-cal, AT4 sub-cal, dragon sub-cal	4 Lanes	Conflicts – N/A
RG 2	WV375302	ITT: Individual tactical training skills. This range is a 2sq. km no fire area.	Blanks, pyrotechnics	N/A	Conflicts – TAC 7C non-firing TNG 1sq km area. No aerial flares.
RG 3	WV379295	HG ASLT: Hand grenade assault course (practice)	Dummy (inert and smoke) hand grenades, blanks, pyrotechnics	6 bays	Conflicts – TAC 7C. No aerial flares.
RG 3A	WV385295	HG LIVE	Fragmentation, concussion, smoke	6 bays	Conflicts – RG 10
RG 4	WV381296	HG ASLT	Dummy (inert and smoke) hand grenades, blanks, pyrotechnics	1 assault course	Conflicts – TAC 7C. No aerial flares.
RG 5	WV385298	Map reading	N/A	N/A	Conflicts – N/A
RG 6	WV387303	Combat pistol qualification (day/night)	.22, .38, .308, .45, .357, 9mm, 10mm, shotgun	12, lanes (RETS) 14, stationary	Conflicts – NW tank trail
RG 6A	WV387301	NJ police academy	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, shotgun	16, pistol 30, M16 zero	Conflicts – NW tank trail
RG 7	WV386299	25 meter multi purpose, M203, LAW, AT4	5.56, 40mm, TPT, 66mm law, 35mm law sub-cal, 7.62, AT4 sub-cal, .50 dragon sub-cal	30, 25 meter 10, M203 and MG	Conflicts – N/A Hard targets to 800 meters. No 25 meter TGT frams, stakes only.
RG 8	WV386298	Anti-armor 40mm	Sub-cal only, TPT only	9 points	Conflicts – N/A Hard targets to 800 meters.
RG 9	WV385296	M203 qualification	40mm TPT	4 lanes	Conflicts – N/A
RG 10	WV381292	Machine Gun (MG) zero	5.56, 7.62, .50	8 lanes	Conflicts – RG 3A
RG 11	WV380288	MG transition & qualification (day/night)	5.56, 7.62, .50	8 lanes zero points	Conflicts – N/A
RG 12	WV377286	Military Operations in Urban Terrain (MOUT).	Blanks, pyrotechnics and smoke	2, one story 5, two story 2faced	Conflicts – N/A No aerial Flares
RG 13	WV381283	M 16 night firing, M31A1 targets at 25 & 50 meters	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56	60 points 25 & 50 meters	Conflicts – N/A
RG 14	WV385279	Recreation Service Trap Range	All small arms, shotgun, archery, .50 muzzle load	N/A	Conflicts – N/A
RG 15	WV387272	Known distance	5.56, 7.62, .50	84 points	Conflicts – N/A
RG 16	WV388270	Field fire, night fire RETS	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62 (M14)	16 points	Conflicts - N/A
RG 17	WV388268	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, shotgun	60 points	Conflicts – N/A Leased to FBI

SITE	LOCATION	TYPE OF SITE	AMMUNITION	# OF LANES/ DEMOLITION AREA	REMARKS
RG 18	WV390266	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	100 points	Conflicts – N/A
RG 19	WV391261	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	60 points	Conflicts – N/A
RG 20	WV393260	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	60 points	Conflicts – N/A
RG 21	WV395261	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	35 points	Conflicts – N/A
RG 22	WV398261	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	35 points	Conflicts – N/A
RG 23	WV399261	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	35 points	Conflicts – N/A
RG 24	WV401259	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	60 points	Conflicts – N/A
RG 25	WV412257	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	37 points	Conflicts _ N/A Leased to Air Force
RG 26	WV416256	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	50 points	Conflicts – N/A
RG 27A	WV417256	25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	30 points	Conflicts – N/A
RG 27B	WV418256	25 meter multipurpose	.22, .38, 308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	30 points	Conflicts – N/A
RG 27C	WV419256	25 meter multipurpose	.22, .38, 308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	30 points	Conflicts – N/A
RG 28	WV419254	25 meter multipurpose	.22, .38, 308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	80 points	Conflicts – N/A Can be increased to 110 points w/targets on stakes.
RG 29	WV424256	25 meter multipurpose	.22, .38, 308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	60 points	Conflicts – N/A Can be increased to 110 points w/targets on stakes.
RG 30 A	WV426254	Day/night defense for squad live, M31A1	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 40mm TOPT, 7.62, shotgun	10 two man covered fighting positions, 2 MG positions	Conflicts – N/A
RG 30 A	WV429255	Fire and maneuver	5.56 BALL, practice HG	4 lanes	Conflicts – N/A

SITE	LOCATION	TYPE OF SITE	AMMUNITION	# OF LANES/ DEMOLITION AREA	REMARKS
RG 31	WV439253	100 meter multipurpose MG zero	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	13, 25 meter 8, 10 meter	Conflicts – N/A
RG 32	WV442253	Field fire, night fire RETS	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62	16 points	Conflicts – N/A 4 firing orders per hour
RG 33	WV444254	100 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	13, 25 meter 8, 10 meter 4 foxhole	Conflicts – N/A
RG 34	WV450254	Qualification course	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62	16 points	Conflicts – N/A
RG 35	WV452253	Record proficiency and qualification range	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62	16 points	Conflicts – N/A 4 firing orders per hour.
RG 37	WV457254	100 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, shotgun	5 points	Conflicts – N/A
RG 38	WV459253	Record proficiency and qualification range	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56	16 points	Conflicts – N/A 4 firing orders per hour
RG 39	WV473260	Mortar firing point 4	60mm, 81mm, 4.2	10 points	Conflicts – N/A
RG 39A	WV470256	Mortar point #3 (alternate 25 meter multipurpose)	60mm, 81mm, 4.2, .22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, shotgun	20 points	Conflicts – N/A
EOR	WV483262	Explosive Ordnance Range (EOR), demolition training	Blasting cap; electric and non-electric, detonation cord, TNT, and Composition C4		Conflicts – N/A
RG 47	WV483278	Mortar scaled RG, MG familiarization	60 mm TPT round	2 points	Conflicts – RG 47A down range
RG 47A	WV483278	Single point tank range, 10 meter MG, 25 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, .50, shotgun, 40mm TPT, HETP	30, 25 meter 8, 10 meter 1, tank point	Conflicts – RG 47 down range MFP 5
RG 47B	WV483278	Rifle and pistol range	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, .40, 40mm (TPT-only)	30 points	Conflicts – RG 47A down range
RG 53	WV483282	MG familiarization	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun	4 points	Conflicts – RG 47 down range, RG 55, MFP6
RG 55	WV480284	Demolition Training	Blasting cap; electric and non-electric, detonation cord, TNT, Composition C4, bangalore torpedo	4 bunkers	Conflicts – RG 53 (when down range setting charges), MFP6
RG 59A	WV464283	Observation point for 59C impact area	N/A	Tower	Conflicts – RG 59E
RG 59B	WV463288	1TT & defensive training	Blanks and pyrotechnics	Demonstration/Training Area	Conflicts – N/A

SITE	LOCATION	TYPE OF SITE	AMMUNITION	# OF LANES/ DEMOLITION AREA	REMARKS
RG 59C	WV461291	U.S. weapons demonstration	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, 0.50, shotgun, 40mm, LAW, AT4, TNT, C4, mortar, 60mm, 81mm, 120mm, artillery 105, 155, 8in, Tow inert, claymore, dragon sub-cal		Conflicts – N/A
RG 59D	WV463294	Anti-armor training	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun, 40mm, LAW & AT4, and dragon sub-cal	4 bunkers 4 MG positions 20 law & AT4 6 M203	Conflicts – 59C OP bunker survey control point
RG 59E	WV469285	Infiltration course	7.62, C4, TNT, pyrotechnics	2 towers	Conflicts – RG 59, ammo must be for overhead fire. ¼ lb. TNT
RG 61	WV466299	Tank and aerial gunnery	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun, 40mm, TPT, 20mm TP, 105mm TP-T,120mm TP-T, 120mm TPCSDS-T, TOW inert; AT4, LAW, 2.75-inch inert, dragon sub-cal	2 course roads FAARP	Conflicts – down range on RG 59C, 59D, 65, 85
RG 63	WV465301	50 meter multipurpose	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun	20 points	Conflicts – RG 61
RG 65	WV465311	Tank and aerial gunnery	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun, 40mm, TPT, 20mm TP,105mm TP-T,120mm TP-T, 120mm TPCSDS-T, TOW inert; AT4, LAW, 2.75-inch inert, dragon sub-cal	2 Coarse Roads FAARP	Conflicts – do not go forward of firing line when RG 71 is hot. Do not go down range past 1500 meters when artillery is firing. RG 61 down range
RG 71	WV461312	Mortar firing point #7, small arms multipurpose	60mm, 81mm, 4.2, .22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun	30, 25 meter	Conflicts – RG 65 down range
RG 75	WV460316	Mortar firing point #10	60mm, 81mm, 4.2	N/A	Conflicts – Bucks Swamp Road
RG 85	WV454323	Tank and aerial gunnery	.22, .38, .308, .45, .357, 9mm, 10mm, 5.56, 7.62, .50, shotgun, 40mm, TPT, 20mm, TP,105mm TP-T,120mm TP-T, 120mm TPCSDS-T, TOW inert; AT4, LAW, dragon sub-cal	2 road courses FAARP	Conflicts – Bucks Swamp Road, RG 61 down range
RG 86	WV458323	Dragon and tow tracking	N/A	5 points	Conflicts – N/A
RG EOD	WV458323	Explosive Ordinance Disposal	As required	Bunker	Conflicts – N/A coordinate with 60th EOD
TD 7	WV328268	Target detection	Blanks and pyrotechnics	Observation line	Conflicts – N/A
TD 8	WV413240	Target detection	Blanks and pyrotechnics	Observation line	Conflicts – N/A
HF 11	WV346275	CS chamber	CS gas pellets and powder	CS chamber	Conflicts – N/A
OBSTCRSE	WV335273	Obstacle course	N/A	17 obstacles	Conflicts – N/A

SITE	LOCATION	TYPE OF SITE	AMMUNITION	# OF LANES/ DEMOLITION AREA	REMARKS
CONFCRSE	WV328267	Confidence course	N/A	21 obstacles	Conflicts – N/A
LRC	WV329268	Leadership Reaction Course	N/A	15 stations	Conflicts – N/A
EPW	WV330265	Enemy Prisoner of War	Blanks and pyrotechnics	POW compound	Conflicts – N/A No aerial flares
RAP/ TOW	WV333267	Rappel tower	N/A	Tower	Conflicts – N/A Requires rappel master
DTA 1	WV363272	Driver training area	N/A	2 miles of asphalt network	Conflicts – TAC 5E
DTA 2	WV353283	Driver training area	N/A	30,000 sq. meter asphalt pad	Conflicts – TAC 5E
DTA 3	WV357286	Driver training area	N/A	2 miles off-road course	Conflicts – TAC 5D
DTA 4	WV469301	Driver training area	N/A	3 miles off-road course	Conflicts – TAC 5D
DTA 5	WV474303	Driver training area	N/A	3 miles off-road course	Conflicts – TAC 9D
DTA 6		Driver training area	N/A	3 miles off-road course	Conflicts – TAC 32C, 32B, 35A, 35C
LN 1	WV331270	Beginners day land navigation	N/A	16 start points 4 lanes EA	Conflicts – N/A
LN 2	WV301276	Intermediate day and advances night land navigation	N/A	4 start points 2 lanes EA	Conflicts – TAC 1F
LN 3	WV366285	Intermediate day and advances night land navigation	N/A	17 start points 4 lanes EA	Conflicts – TAC 5A-G
LN 4	WV487254	Intermediate day and advances night land navigation	N/A	7 start points 2 lanes EA	Conflicts – TAC 12A/B, 13B, C, D, AFP 6, 7, 10, 11, 13, 21
FG01	WV332284	Physical training	N/A	1 miles track, PT building	Conflicts – N/A
FF24	WV335276	Physical training	N/A	¼ mile track	Conflicts – N/A
FF79	WV338279	Physical training	N/A	¼ mile track	Conflicts – N/A
CTT	WV333261	Common task training	Blanks and pyrotechnics	N/A	Conflicts – N/A No aerial flares

3.3 Land Use Compatibility Guidelines

3.3.1 Noise Zones

This part of the ENMP study consists of guidelines for acceptable noise levels for adjacent off-base and on-base land uses. To determine land use compatibility, the noise exposure area is divided into three noise zones. Noise Zone I (noise levels less than 65dB DNL) is an area of minimal impact, and guidelines show compatibility with most uses; however, for sensitive land uses, guidelines require additional evaluation. Noise Zone II (noise levels between 65dB and 75dB DNL) is an area of moderate impact. Noise Zone III (noise levels in excess of 75dB DNL) is the most severely impacted area. Additional information on these noise zones and their affected environs is presented in Section 4.5.1. Table 3-2 presents land use capability guidelines as defined by the U.S. Department of Transportation, Standard Land Use Coding Manual.

3.3.2 Clear Zones and Accident Potential Zones

Aircraft operations are conducted according to U.S. Army and Federal Aviation Administration procedures and requirements. Flight paths are established to minimize risks associated with air operations. A concern at Fort Dix is the fact that Fort Dix lies under the approach and departure routes for McGuire AFB and, to a lesser extent, Lakehurst NAEC.

The framework for land use planning in airfield environments is the identification of Accident Potential Zones (APZs). There are three types of APZs, extending out from the ends of the runway along the approach and departure paths. The Clear Zone, the area closest to the runway end, is the most hazardous. The overall risk is so high that the Department of Defense generally acquires the land through purchase or easement to prevent development. APZ I is an area beyond the Clear Zone and possesses a significant potential for accidents. APZ II is an area beyond APZ I having measurable potential for accidents. Current APZs at Fort Dix do not impact surrounding communities. Information on APZs associated with McGuire AFB can be found in the McGuire AFB AICUZ Study dated 1995.

3.4 Participation in the Planning Process

As local communities prepare their land use plans, the Army must be ready to provide additional inputs. The Department of Public Works (DPW) has been designated as the official liaison with the local community on all planning matters. This office is prepared to participate in the continuing discussion of zoning and other land use matters as they may affect, or may be affected by, Fort Dix.

Table 3-2. Land Use Compatibility

LAND USE		NOISE ZONES			
SLUCM NO.	NAME	65-69 dB	70-74 dB	75-79 dB	80+ dB
10	**Residential**				
11	Household units				
11.11	Single units; detached	A[1]	B[1]	N	N
11.12	Single units; semidetached	A[1]	B[1]	N	N
11.13	Single units; attached row	A[1]	B[1]	N	N
11.21	Two units; side-by-side	A[1]	B[1]	N	N
11.22	Two units; one above the other	A[1]	B[1]	N	N
11.31	Apartments; walk up	A[1]	B[1]	N	N
11.32	Apartments; elevator	A[1]	B[1]	N	N
12	Group quarters	A[1]	B[1]	N	N
13	Residential hotels	A[1]	B[1]	N	N
14	Mobile home parks or courts	N	N	N	N
15	Transient lodgings	A[1]	B[1]	C[1]	N
16	Other residential	A[1]	B[1]	N	N
20	**Manufacturing**				
21	Food & kindred products; manufacturing	Y	Y[2]	Y[3]	Y[4]
22	Textile mill products; manufacturing	Y	Y[2]	Y[3]	Y[4]
23	Apparel and other finished products made from fabrics, leather, and similar materials; manufacturing	Y	Y[2]	Y[3]	Y[4]
24	Lumber and wood products (except furniture); manufacturing	Y	Y[2]	Y[3]	Y[4]
25	Furniture and fixtures; manufacturing	Y	Y[2]	Y[3]	Y[4]
26	Paper & allied products; manufacturing	Y	Y[2]	Y[3]	Y[4]
27	Printing, publishing, and allied industries	Y	Y[2]	Y[3]	Y[4]
28	Chemicals and allied products; manufacturing	Y	Y[2]	Y[3]	Y[4]
29	Petroleum refining and	Y	Y[2]	Y[3]	Y[4]

LAND USE		NOISE ZONES			
SLUCM NO.	NAME	65-69 dB	70-74 dB	75-79 dB	80+ dB
	related industries				
30	**Manufacturing**				
31	Rubber and misc. plastic products, manufacturing	Y	Y[2]	Y[3]	Y[4]
32	Stone, clay and glass products manufacturing	Y	Y[2]	Y[3]	Y[4]
33	Primary metal industries	Y	Y[2]	Y[3]	Y[4]
34	Fabricated metal products; manufacturing	Y	Y[2]	Y[3]	Y[4]
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks manufacturing	Y	A	B	N
39	Miscellaneous manufacturing	Y	Y[2]	Y[3]	Y[4]
40	**Transportation, communications and utilities**				
41	Railroad, rapid rail transit and street railroad transportation	Y	Y[2]	Y[3]	Y[4]
42	Motor vehicle transportation	Y	Y[2]	Y[3]	Y[4]
43	Aircraft transportation	Y	Y[2]	Y[3]	Y[4]
44	Marine craft transportation	Y	Y[2]	Y[3]	Y[4]
45	Highway & street right-of-way	Y	Y[2]	Y[3]	Y[4]
46	Automobile parking	Y	Y[2]	Y[3]	Y[4]
47	Communications	Y	A[5]	B[5]	N
48	Utilities	Y	Y	Y[2]	Y[3]
49	Other transportation communications and utilities	Y	A[5]	B[5]	N
50	**Trade**				
51	Wholesale trade	Y	Y[2]	Y[3]	Y[4]
52	Retail trade-building materials, hardware and farm equipment	Y	Y[2]	Y[3]	Y[4]
53	Retail trade-general merchandise	Y	A	B	N
54	Retail trade-food	Y	A	B	N

LAND USE		NOISE ZONES			
SLUCM NO.	NAME	65-69 dB	70-74 dB	75-79 dB	80+ dB
55	Retail trade-automotive, marine craft, aircraft and accessories	Y	A	B	N
56	Retail trade-apparel and accessories	Y	A	B	N
57	Retail trade-furniture, home furnishings and equipment	Y	A	B	N
58	Retail trade-eating and drinking establishments	Y	A	B	N
59	Other retail trade	Y	A	B	N
60	**Services**				
61	Finance, insurance and real estate services	Y	A	B	N
62	Personal services	Y	A	B	N
62.4	Cemeteries	Y	Y[2]	Y[3]	Y[4,11]
63	Business services	Y	A	B	N
64	Repair services	Y	Y[2]	Y[3]	Y[4]
65	Professional services	Y	A	B	N
65.1	Hospitals, nursing homes	A*	B*	N	N
65.1	Other medical facilities	Y	A	B	N
66	Contract construction services	Y	A	B	N
67	Governmental services	Y*	A*	B*	N
68	Educational services	A*	B*	N	N
69	Miscellaneous services	Y	A	B	N
70	**Cultural, entertainment and recreational**				
71	Cultural activities (including churches)	A*	B*	N	N
71.2	Nature exhibits	Y*	N	N	N
72	Public assembly	Y	N	N	N
72.1	Auditoriums, concert halls	A	B	N	N
72.11	Outdoor music shell, amphitheaters	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	Y[7]	Y[7]	N	N
73	Amusements	Y	Y	N	N

LAND USE		NOISE ZONES			
SLUCM NO.	NAME	65-69 dB	70-74 dB	75-79 dB	80+ dB
74	Recreational activities (including golf courses, riding stables, water recreation)	Y*	A*	B*	N
75	Resorts and group camps	Y*	Y*	N	N
76	Parks	Y*	Y*	N	N
79	Other cultural, entertainment and recreation	Y*	Y*	N	N
80	**Resources production and extraction**				
81	Agriculture (except livestock)	Y[8]	Y[9]	Y[10]	Y[10,11]
81.5 to 81.7	Livestock farming and animal breeding	Y[8]	Y[9]	Y[10]	Y[10,11]
82	Agricultural related activities	Y[8]	Y[9]	N	N
83	Forestry activities and related services	Y[8]	Y[9]	Y[10]	Y[10,11]
84	Fishing activities and related services	Y	Y	Y	Y
85	Mining activities and related services	Y	Y	Y	Y
89	Other resources production and extraction	Y	Y	Y	Y

LEGEND

SLUCM - Standard Land Use Coding Manual, U.S. Department of Transportation.

Y - (Yes) - Land uses and related structures are compatible without restriction.

N - (No) - Land use and related structures are not compatible and should be prohibited.

A, B, or C - Land use and related structures generally compatible; measures to achieve NLR for A (DNL / 65-69), B (DNL / 70-74), C (DNL / 75-79), need to be incorporated into the design and construction of structures.

A*, B*, and C* - Land use generally compatible with NLR. However, measures to achieve an overall noise level reduction do not necessarily solve noise difficulties and additional evaluation is warranted. See appropriate footnotes.

* - The designation of these uses as "compatible" in this zone reflects individual federal agencies' and program considerations of general cost and feasibility factors, as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

NOTES

1)

a) Although local conditions may require residential use, it is discouraged in DNL 65-69 dB and strongly discouraged in DNL 70-74 dB. The absence of viable alternative development options should be determined and an evaluation indicating a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

b) Where the community determines the residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) for DNL 65-69 dB and DNL 70-74 dB should be incorporated into building codes and considered in individual approvals.

c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, and design and use of berms and barriers can help mitigate outdoor exposure, particularly from near ground level sources. Measures that reduce outdoor noise should be used whenever practical in preference to measures which only protect interior spaces

2) Measures to achieve the same NLR as required for facilities in DNL 65-69 dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

3) Measures to achieve the same NLR as required for facilities in DNL 70-74 dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

4) Measures to achieve the same NLR as required for facilities in DNL 75-79 dB range must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

5) If noise sensitive, use indicated NLR; if not, the use is compatible.

6) No buildings.

7) Land use is compatible provided special sound reinforcement systems are installed.

8) Residential buildings require the same NLR as required for facilities in DNL 65-69 dB range.

9) Residential buildings require the same NLR as required for facilities in DNL 70-74 dB range.

10) Residential buildings are not permitted.

11) Land use is not recommended. If the community decides the use is necessary, personnel should wear hearing protection devices.

4.0 LAND USE ANALYSIS

4.1 Introduction

Land use planning and control is a dynamic process. The specific characteristics of land use determinants will always reflect, to some degree, the changing conditions of the economic, social, and physical environment of a community, as well as changing public concern. The planning process accommodates this fluidity, in that decisions are not normally based on boundary lines, but rather on more generalized area designations.

For the purpose of this study, land use and zoning classifications are as follows:

- Residential. Includes all types of residential activity, such as single and multi-family residences at unit densities of one per acre and greater.
- Commercial. Offices, retail establishments, restaurants, etc.
- Industrial. Manufacturing, warehouses, and other similar uses.
- Public/Quasi-Public. Publicly owned lands and lands open to public access, including military reservations, public buildings, schools, churches, cemeteries, and hospitals.
- Recreational/Natural Resource Conservation. Land designated for recreational and conservation activity, including parks, golf courses, state forests, and other conservation areas.
- Open/Agricultural/Low Density. Undeveloped land, agricultural areas, grazing lands, and low density residential activity with less than one dwelling unit per acre.

4.2 Existing Land Use

Fort Dix consists of 30,950 acres of land, of which 13,765 acres are range and impact areas and 14,000 acres are classified as contiguous maneuver areas. The remainder of the installation comprises the Cantonment Area, which includes all military command and support facilities, on-base military housing, recreation facilities, and community support functions. Other land uses on

the installation include the Federal Correctional Institution (FCI) at Fort Dix, overseen by the Federal Bureau of Prisons; Midstate Prison, overseen by the State of New Jersey; and a small recreation area adjacent to Brindle Lake. The area around the base is largely rural, and much of the land is either in agricultural production or forested.

The western portion of the installation is located within Burlington County. Burlington County jurisdictions surrounding the installation include McGuire AFB; the townships of North Hanover, New Hanover, Pemberton, Chesterfield, and Springfield; and Wrightstown Borough. The eastern portion of the installation is located within Ocean County. The Ocean County townships of Plumsted and Manchester border the installation boundary to the northeast and southeast, respectively. Other land uses bordering Fort Dix include Lakehurst NAEC to the east and Lebanon State Forest to the south and east (Figure 4-1). Descriptions of the land use areas surrounding the installation are given below.

Burlington County

The Burlington County Office of Land Use Planning identifies the following land use designations for areas surrounding Fort Dix:

- Single Family
- Agriculture
- Mining
- Wooded
- Vacant
- Water
- Multi-Family
- Manufacturing
- Transportation
- Utility
- Commercial/Services
- Community Services
- Military
- Recreation

The jurisdictions bordering Fort Dix military installation within Burlington County are Pemberton Township, New Hanover Township, and Wrightstown Borough.

Figure 4-1

Pemberton Township

Land use patterns within Pemberton Township are varied, including a considerable amount of low density and agricultural lands, as well as intensive commercial and residential development in Browns Mills, a community located directly south of Fort Dix. Existing land use designations within Pemberton Township include primarily agricultural and wooded areas southwest of the installation boundary. The Browns Mills area includes primarily single family and multi-family residential, commercial, and water (Mirror Lake) (Burlington County 1997). Single family dwellings are located along the southern border of the Range Area. The residential dwellings are located across form Ranges 20 through 24 and are located approximately 300 to 1000 feet from the firing ranges.

New Hanover Township

New Hanover Township includes the northwestern portions of Fort Dix, including the Cantonment Area, and McGuire AFB. The most significant land uses within this township include military lands, single family residential, agriculture, and wooded areas. The town of Cookstown, located directly north of the installation, is located within New Hanover Township; land uses in the Cookstown area include primarily single family residential, commercial, and agriculture (Burlington County 1997).

Wrightstown Borough

Wrightstown Borough is a small community located directly north of the Fort Dix Cantonment Area and the western portion of McGuire AFB. The Borough is small in comparison to the surrounding townships. Land uses in Wrightstown comprise commercial/services and single and multi-family residential uses. Wooded areas and agriculture are located in the outskirts of the Borough (Burlington County 1997).

Springfield Township

The Township of Springfield is located northwest of the Fort Dix Cantonment Area and McGuire AFB. Land uses within the Township of Springfield are comprised of recreational, light industrial uses, commercial/services, and single and multi-family residential uses. Wooded area and agriculture are also dominant land uses within the Township of Springfield (Burlington County 1997).

Ocean County

The Ocean County Department of Planning identifies the following land use designations for areas surrounding Fort Dix:

Residential	Agriculture
Commercial	Forest
Military	Water
Urban	Wetlands
Recreation	Barren/Transitional

The jurisdictions bordering Fort Dix military installation within Ocean County are Plumsted Township, Manchester Township, and Lakehurst NAEC. In addition, a large portion of Lebanon State Forest is located within Manchester Township. Land uses within these jurisdictions are described below.

Plumsted Township

Plumsted Township comprises the majority of the eastern portion of Fort Dix, including the impact areas for ordnance firing at the ranges. Plumsted Township is largely comprised of military, forest, water/wetlands, agriculture, and other low density land uses, as well as the community of New Egypt. The land uses bordering the installation to the north include

agriculture and forest, with mixed residential uses. Some single family residential uses are located adjacent to the northern boundary of installation within Plumsted Township (Ocean County 1997).

Manchester Township

Manchester Township comprises the extreme southeastern portion of the installation. This area primarily includes forested areas associated with Lebanon State Forest, open water, and the community of Whiting. The Township is largely undeveloped with the exception of Whiting. Land uses in the Whiting area include extensive residential with some scattered commercial and multi-family uses (Ocean County 1997). A single family residential development west of Whiting borders the installation boundary directly east of Tactical Training Area 12C.

Lakehurst Naval Air Engineering Center

Lakehurst Naval Air Engineering Center borders the installation to the east. Land uses at Lakehurst include military, forested areas, open water, and barren/transitional (Ocean County 1997). Military uses on the station include a catapult runway, rocket sleds, a parachute drop zone, aircraft runways, and associated air station facilities.

Lebanon State Forest

The Lebanon State Forest is comprised of 39,965 acres of open forest that borders the installation to the southeast. Land uses within the State Forest are primarily restricted to forested areas, recreation, and limited agriculture (Ocean County 1997). Recreational activities allowed within Lebanon State Forest include hiking, camping (82 campsites), biking, hiking, cross-country skiing, boating, and hunting (in specified areas). Although low-density residential development is allowed within the Lebanon State Forest, it is limited; no residential development within the State Forest boundary abuts the Fort Dix installation boundary.

Federal Bureau of Prisons

The Federal Correctional Institute at Fort Dix is located along Pointville Road in the southern portion of the garrison; it is a low security corrections center for all inmates. The institution consists of east and west facilities, both located along Pointville Road within the confines of Fort Dix. Fort Dix has exclusive jurisdiction over this facility.

Midstate Prison

The Midstate Prison at Fort Dix is located along Range Road in the eastern portion of the Range area; it is a low security corrections center for all inmates. Fort Dix also has exclusive jurisdiction over this facility.

4.3 Current Zoning

All lands in the vicinity of Fort Dix are zoned by their respective townships and boroughs. Jurisdictions responsible for zoning designations, maps, and associated ordinances adjacent to Fort Dix Military Reservation include Pemberton Township, New Hanover Township, and Wrightstown Borough in Burlington County; and Plumsted Township and Manchester Township in Ocean County. Because of the extensive land coverage and vast differences among the zoning designations of different jurisdictions, zoning designations for all lands surrounding Fort Dix are not provided in this study. However, zoning designations are provided in Section 4.5 for the areas potentially affected by maneuvers and range operations on the installation.

4.4 Future Land Use and Zoning

Fort Dix Military Reservation

Planned land uses at Fort Dix Military Reservation are expected to parallel existing conditions, to provide training support to active and reserve component units of all services and licensed non-DoD activities. No changes in the existing layout of the range/impact areas at Fort Dix are anticipated; however, introduction of new weapons and training systems may have an effect on surrounding land uses. Therefore, all new weapons and training activities proposed for use on the ranges or within the training areas shall be evaluated to ensure their compatibility with the surrounding communities.

Affected Jurisdictions

Future land use patterns are expected to remain consistent with current patterns in the surrounding townships, with some new residential, commercial, and industrial development occurring in accordance with approved zoning ordinances and land planning. Most area jurisdictions have general plans or master plans that are either current or under revision.

General/Master Plan Information

Future land use patterns are expected to remain consistent with patterns, with some new residential, commercial, and industrial development occurring in accordance with zoning ordinances. Most area jurisdictions have master plans which are either current or under revision. Increasing residential development pressure is becoming apparent as people search for alternatives to more crowded and expensive conditions in major urban areas.

Future land use planning must also take in to account the New Jersey Pinelands, which is located within the Fort Dix boundaries and the surrounding townships to the north, east, and south.

Federal legislation in 1978 created the Pinelands National Reserve, a mosaic of upland, aquatic, and wetland environments occupying approximately 400,000 acres. The Pinelands Commission has implemented land development regulations in the Comprehensive Management Plan, which regulates and mitigates development depending upon the classification of the lands. These classifications include Agricultural Production Areas, Rural Development Area, Preservation Area, Military Installation Zone, and Regional Growth Area, as well as many other classifications. The Pinelands extend over a considerable portion of Burlington and Ocean Counties, particularly Pemberton, New Hanover, Plumsted, Manchester and Jackson Townships.

4.5 Incompatible Land Uses

4.5.1 Noise Zones

The MicroBNOISE computer model used to produce the noise contours for range operations at Fort Dix identified only one potential area of noise impacts associated with current training operations. The area of potential noise impact is located in the southeastern portion of the installation and includes off-base areas within the northwestern portion of Manchester Township (including areas within Lebanon State Forest) and the southwestern portion of Plumsted Township (Figure 4-2). The potential noise impact area is just south of the Fort Dix Explosive Ordnance Disposal (EOD) area. Noise Zones identified in this area include Zone I (noise levels less than 65$_{dB}$) and Zone II (noise levels between 65$_{dB}$ and 75$_{dB}$). Although Zone II is normally unacceptable for sensitive land uses such as schools, housing, and hospitals, it is compatible with undeveloped forested areas. Currently, the Lebanon State Forest is zoned as a recreational and natural resource conservation area and, therefore, its associated land uses are considered compatible with training operations at Fort Dix.

Figure 4-2

Zoning Information from Manchester and Plumsted Township

Manchester Township

A review of the Interim Zoning Map for Manchester Township (Ocean County, revised through Ordinance 97-038; Adopted 1/26/98) shows that the majority of the land surrounding the southeast corner of Fort Dix is zoned PPA (Pineland Preservation Area) this includes the Lebanon State Forest (identified as Noise Zones I and II). Small parcels of land adjacent to the southeasternmost portion of Fort Dix are zoned R, PFA-R, and WTRA: Recycling Facility, Pineland Forest Area - Receiving, and Whiting Town Rural Agriculture, respectively. Zoning for these areas is compatible with noise guidelines for Noise Zones I and II.

Pemberton Township

Zoning for the area of Browns Mills, bordering ranges 20 through 24, is zoned R-80 and R-1, very high density single family residential and high density single family residential, respectively (Burlington County, February 1997, Revised January 1998). The northernmost portions of this community, along Range Road, are exposed to noise levels of 65dB or less. Zoning for this area is compatible with noise guidelines.

Plumsted Township

Impacted areas within this Township are located within the confines of Fort Dix. This area is owned by the State of New Jersey and, according to the Plumsted Township Code Enforcement Officer, the zoning is controlled by the military, i.e., Fort Dix.

4.5.2 Clear Zones and Accident Potential Zones

Aircraft operations at Fort Dix Military Reservations consist of maneuver training, range training, and live fire exercises for helicopters; no fixed wing aircraft operate at Fort Dix. The heliport area on base is located in the eastern portion of the Cantonment Area, directly adjacent to the runways at McGuire AFB. In addition, small helicopter landing areas have been established in Tactical Training Area 13C, ARDEC, Ranges 16, 38, 47, 61 and 85. No clear zones or accident potential zones are established for helicopter operations; therefore, no incompatible land uses are located on the installation or within the surrounding communities.

4.5.3 Planning Considerations

ENMP noise contours describe the noise characteristics of a specific operational environment and will change if a significant operational change is made. If the local communities surrounding Fort Dix attempt to use the currently identified noise contours as boundary lines for zoning districts, it is conceivable that future problems could result. Should a new mission that results in a significant change to current noise levels be established at Fort Dix, the ENMP would be amended. In addition, the U.S. Army recommends that ENMP data be utilized with other available planning data. Therefore, specific land-use control decisions should not be based solely on ENMP boundaries.

4.5.4 Recommendations

The Fort Dix ENMP study identified potential impacts to off-base lands within three jurisdictions: Manchester Township, Plumsted Township, and Lebanon State Forest. Potential impacts are identified as excessive noise levels ($>$65dBA) extend past the Fort Dix boundaries. Impacts to these areas should be considered by local planners when revising land use plans, ordinances, and zoning restrictions in order to provide a uniform standard in the geographical areas affected by activities at Fort Dix. Other jurisdictions in the area that are not currently affected but may be affected by future operations at the installation include Pemberton Township,

New Hanover Township, Wrightstown Borough, and FCI Fort Dix. The following recommendations are provided for the communities surrounding Fort Dix.

Manchester Township

Fort Dix recommends that any new housing proposed in the area impacted by Zone II noise contours be required to incorporate noise level reduction techniques in the building design. In addition, it is recommended that a condition of sale or lease of land and/or existing facilities located in these Zones include notification of the buyer/lessor of the potential noise impacts in writing. It is further recommended that uses compatible with Zones II and III noise levels be considered for these areas. Some examples of such uses include agricultural, industrial, commercial, and recreational uses.

Plumsted Township

As stated for Manchester Township, Fort Dix recommends noise reduction for new structures and conditions of notification for sale or lease of land within Zone II. It is further recommended that uses compatible with Zones II and III noise levels be considered for these areas.

Lebanon State Forest

No impacts to existing land use are anticipated assuming that land currently administered by Lebanon State Forest continues to be utilized as at present. Noise Zones I and II, located in the northern portion of the forest bordering Fort Dix, are compatible with current land uses.

Pemberton Township

At present, there is no indication of any adverse noise impacts for this area as a result of operations at Fort Dix. It is recommended that those areas near Fort Dix be zoned such that any

future sale or lease of land and/or buildings be required to carry a statement that informs the buyer/lesser of potential future noise impacts.

New Hanover Township

At present, there is no indication of any adverse noise impacts for this area as a result of operations at Fort Dix. It is recommended that those areas near Fort Dix be zoned such that any future sale or lease of land and/or buildings be required to carry a statement that informs the buyer/lesser of potential future noise impacts.

Federal Bureau of Prisons

At present, there is no indication of any adverse noise impacts caused by current operations at Fort Dix.

Mid State Prison

At present, there is no indication of any adverse noise impacts caused by current operations at Fort Dix.

5.0 MITIGATION MEASURES

5.1 Introduction

The implementation of the Environmental Noise Management Plan (ENMP) Program should be a joint effort between the Army and the adjacent communities. The Army has the role of minimizing the impact on their local communities of Fort Dix operations. The communities' role is to ensure that development of the environs is compatible with good planning principles and practices.

5.2 Steps Taken by Fort Dix

Fort Dix has taken several steps to reduce the amount of noise generated by training operations. These actions include the following:

- The firing of artillery and mortars is generally prohibited between the hours of 11:30 pm and 7:00 am.

- All explosive ordnance is restricted to charges that do not exceed 25 lb. The 25-lb limit may be exceeded by exception, only when approved by the installation commander.

- To reduce noise levels, units equipped with 155mm howitzers will, when possible, substitute high explosive rounds with low cost indirect training round (LITR).

- The recent introduction of a cartridge, 81 mm: target practice (short range), the M880, will significantly reduce noise when used in conjunction with both the 81mm and 120mm heavy mortars. Approximately 30% of all 81mm and 120mm rounds fired are M880 training rounds.

- Fort Dix simulates the firing of artillery and mortars for the training of forward observers. The use of simulators reduces the amount of artillery and mortar firing necessary to train forward observers by approximately 50%.

- The Weaponeer and the engagement skills trainer are used to simulate the firing of the M16A2 rifle during the initial phase of training.

- Vehicle convoys traveling on range road are not to exceed 15 vehicles.

5.3 Suggestions for the Community

In addition to the steps taken by Fort Dix, neighboring communities can further reduce the impacts of undesirable noise in the following ways:

Noise Level Reduction Techniques

Double glazed windows, solid core doors, heavy drapes and carpets, acoustic ceiling treatment, and acoustic construction of roofs and floors are all techniques that, if incorporated into the design of a given facility, can significantly reduce noise levels.

Building Location

The effect of noise on a community can be further decreased by thoughtfully selecting the location of proposed facilities. One way to achieve this is to utilize the natural acoustical shielding associated with the terrain and natural landscape. Another is to stagger the layout of buildings and avoid locating buildings in a parallel fashion.

Zoning Regulations

Zoning regulations that correspond with Noise Zones II and III could be changed to require all new homes, schools, libraries, offices, etc. constructed within the Zone II area to incorporate noise reducing techniques in their designs, and restrict any new construction of all the above facilities in Zone III. Furthermore, noise standards should be incorporated into the existing health codes to ensure that developers use the land in a compatible fashion or design structures to include noise control features.

By creating subdivision regulations, the community can require new developments located within noise-sensitive areas to create buffer strips or require the installation of noise barriers.

HUD and VA Policies

The Department of Housing and Urban Development (HUD) and the Veterans Administration (VA) have their own requirements when granting federal loans in noise-sensitive areas. At present, both agencies include the refusal of support for new homes constructed in Zone III areas. They also require new homes that are proposed for Zone II areas to include adequate noise attenuation features if the residents request full mortgage support. For homes already in Zone II areas, HUD and the VA will not deny a mortgage based on the noise alone. For homes located in Zone III areas, HUD and the VA will base mortgage support on the actual value of the home.

Zones II and III - Industrial

The community can also work with Fort Dix by requiring industrial, manufacturing, and laboratory facilities Zones II and III to incorporate noise level reduction techniques into the design and construction of the portions of the buildings where the public is received, where office areas exist, and in areas where the noise level is high.

Zones II and III - Additional

Provided that special sound reinforcement systems are installed, outdoor sports arenas and areas where outdoor spectator sports are held are compatible in Zone II areas.

Outdoor sports arenas, parks, recreational areas, livestock farms, and animal breeding facilities should be restricted in Zone III areas. In addition, indoor pools and gymnasiums should incorporate noise attenuation features in their design and construction.

APPENDIX A
THE ENMP CONCEPT, PROGRAM, METHODOLOGY, AND POLICIES

A.1 Concept

Federal legislation, national sentiment, and other external forces that directly affect the U.S. Army mission have greatly increased the U.S. Army role in environmental and planning issues. Problems of military encroachment from incompatible land uses surrounding installations, as well as air and water pollution and socioeconomic impact, require continued and persistent U.S. Army involvement. The nature of these issues dictates U.S. Army participation in comprehensive community and land use planning. Effective, coordinated planning that bridges the gap between the federal government and the community requires the establishment of good working relationships with local citizens, local planning officials, and state and federal officials. This planning depends upon creating an atmosphere of mutual trust and helpfulness. The Environmental Noise Management Program (ENMP) concept has been developed in an effort to:

- Control environmental noise to protect the health and welfare of people, on- and off-post, impacted by all Army-produced noise, including on- and off-post noise sources
- Reduce community annoyance from environmental noise to the extent feasible, consistent with Army training and material testing activities.

The land use guidelines developed herein are a composite of a number of other land use compatibility studies that have been refined to fit the Fort Dix Military Reservation (Fort Dix) aviation environment.

A.2 Program

Installation Commanders establish and maintain active programs to achieve the maximum feasible land use compatibility between air installations and neighboring communities. The program requires that all appropriate governmental bodies and citizens be fully informed whenever ENMP or other planning matters affecting the installation are under consideration. This includes positive and continuous programs designed to:

- Provide information, criteria, and guidelines to federal, state, regional, and local planning bodies, civic associations, and similar groups
- Inform such groups of the requirements of the flying activity, noise exposure, aircraft accident potential, and ENMP plans
- Describe the noise reduction measures that are being used
- Ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing activities. These measures include such considerations as proper location of engine test facilities, provision for sound suppressors where necessary, and adjustment of flight patterns and/or techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

A.3 Methodology

The ENMP analyzes land areas upon which certain land uses may obstruct airspace or otherwise be hazardous to aircraft operations and land areas that are exposed to the health, safety, or welfare hazards of aircraft operations. The ENMP includes noise zones (NZs) produced by the computerized Day-Night Average A-Weighted (DNL) and C-Weighted (CDNL) metrics (Appendix B).

A.4 ENMP Land Use Development Policies

The basis for any effective land use control system is the development of, and subsequent adherence to, policies that serve as the standard by which all land use planning and control actions are evaluated. Fort Dix recommends that policies be considered for incorporation into the comprehensive plans of agencies in the vicinity of the base environs.

The Army environmental noise policies are based on land use compatibilities as indicated by objective noise levels. Under the environmental noise program, the Army will:

- Continually evaluate the impact of noise that may be produced by ongoing and proposed Army activities, and minimize impacts and annoyance to the greatest extent practicable.
- Comply with applicable federal laws and regulations respecting the management of environmental noise. Questions regarding the applicability of state and local laws and regulations should be referred to the command legal officer and through channels to Headquarters Department of the Army, Environmental Law Division for ultimate resolution.
- Maintain an active environmental noise management program to protect the present and future operational capabilities of the installation or facility. Encroachment problems are caused by land uses that are not compatible with the existing and future noise environments, both on and off the installation. Predictions for long-range planning purposes can be made for several years into the future.
- Assess the effect of noise from both on- and off-post sources and identify mitigation measures for incompatible land uses.
- Reduce interior noise to acceptable levels through architectural and engineering controls for buildings with sensitive activities such as medical treatment, education, and general living.

- Maintain a noise complaint management program. Noise complaints will be handled with integrity, sensitivity, and timeliness.
- Monitor the noise environment to verify levels that have produced major public and/or political controversy. Short-term monitoring can be used for this purpose. Long-term monitoring is useful for complaint and damage claim management.
- Develop and procure weapons systems and other military combat equipment that produce less noise and comply with regulatory noise emissions standards.
- Procure commercially manufactured products, or those adapted for general military use, that produce less noise and comply with regulatory noise emissions standards.
- Consider acquisition of property rights solely on the basis of incompatible noise levels only after all practical means of achieving acceptable levels have been exhausted, and the operational integrity of the mission is threatened.

A.5 Basic Land Use Compatibility

Compatibility guidelines must not be considered inflexible standards. They are the framework within which land use compatibility questions can be addressed and resolved. In each case, full consideration must be given to local conditions such as:

- Previous community experience with aircraft accidents and noise
- Local building construction and development practices
- Existing noise due to other urban or transportation noise sources
- Time period of aircraft operations and land use activities
- Specific site analysis
- Noise buffers, including topography.

These basic guidelines cannot resolve all land use compatibility questions, but they do offer a reasonable framework within which to work.

A.7 Noise

Nearly all studies on residential aircraft noise compatibility recommend no residential uses in noise zones above DNL 75 decibels (dB). Usually, no restrictions are recommended below noise zone DNL 65 dB. Between DNL 65 and 75 dB, there is currently no consensus. These areas may not qualify for federal mortgage insurance in residential categories according to the Department of Housing and Urban Development (HUD) (24 Code of Federal Regulations [CFR] 51B). In many cases, HUD approval requires noise attenuation measures, the Regional Administrator's concurrence, and an Environmental Impact Statement. The Department of Veterans Affairs also has airfield noise and accident restrictions that apply to their home loan guarantee program. Whenever possible, residential land use should be located below DNL 65 dB according to U.S. Army land use recommendations.

Most industrial/manufacturing uses are compatible in the airfield environs. Exceptions are uses such as research or scientific activities, which require lower noise levels. Noise attenuation measures are recommended for portions of buildings devoted to office use, receiving the public, or where the normal background noise level is low.

The transportation, communications, and utilities categories have a high noise level compatibility because they generally are not people-intensive. When people use land for these purposes, the use is generally very short in duration. Where buildings are required for these uses, additional evaluation is warranted.

The commercial/retail trade and personal and business services categories are compatible without restriction up to DNL 70 dB; however, they are generally incompatible above DNL 80 dB. Between DNL 70 and 80 dB, noise level reduction measures should be included in the design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment, and attempts should be made to locate these uses below DNL 65 dB (a U.S. Army land use recommendation) or provide adequate noise level reduction.

Although recreational use has often been recommended as compatible with high noise levels, recent research has resulted in a more conservative view. Above DNL 75 dB, noise becomes a factor, which limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (e.g., music shell), compatibility is limited. Buildings associated with golf courses and similar uses should be noise attenuated.

With the exception of forestry activities and livestock farming, uses in the resources production, extraction, and open space category are compatible almost without restrictions.

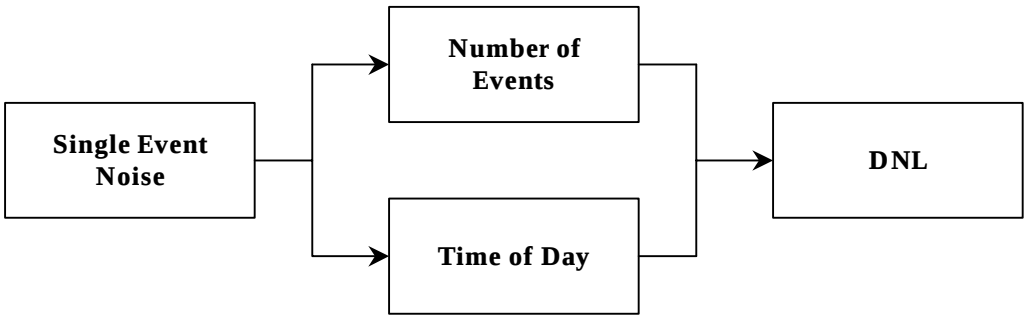
APPENDIX B
DESCRIPTION OF THE NOISE ENVIRONMENT

B.1 Noise Environment Descriptor

The noise contour methodology used herein is the Day-Night Average Sound Level (DNL) metric of describing the noise environment. Efforts to provide a national uniform standard for noise assessment have resulted in adoption by the United States Environmental Protection Agency of DNL as the standard noise descriptor. The U.S. Army uses the DNL descriptor in assessing the amount of aircraft noise exposure, and as a metric for community response to the various levels of exposure. The DNL values used for planning purposes are 65, 70, 75, and 80 decibels (dB). Land use guidelines are based on the compatibility of various land uses with these noise exposure levels.

It is generally recognized that a noise environment descriptor should consider, in addition to the annoyance of a single event, the effect of repetition of such events and the time of day in which these events occur. DNL begins with a single event descriptor and adds corrections for the number of events and the time of day. Because the primary development concern is residential, nighttime events are considered more annoying than daytime events and are weighted accordingly. DNL values are computed from the single event noise descriptor, plus corrections for number of events and time of day (Figure B-1).

Figure B-1. Day-Night Average Sound Level (DNL)



Noise is represented by a variety of quantities, or "metrics". Each noise metric was developed to account for the type of noise and the nature of what may be exposed to the noise. Human hearing is more sensitive to medium and high frequencies than to low and very high frequencies, so it is common to use "A-weighted" metrics that account for this high frequencies and "C-Weighted" metrics for low frequencies.

As part of the extensive data collection process, detailed information is gathered on the type of aircraft, the number, and time of day of flying operations for each flight track during a typical day. This information is used in conjunction with the single event noise descriptor to produce DNL values. These values are combined on an energy summation basis to provide single DNL values for the mix of aircraft operations at the base. Equal value points are connected to form the contour lines.

B.2 Noise Event Descriptor

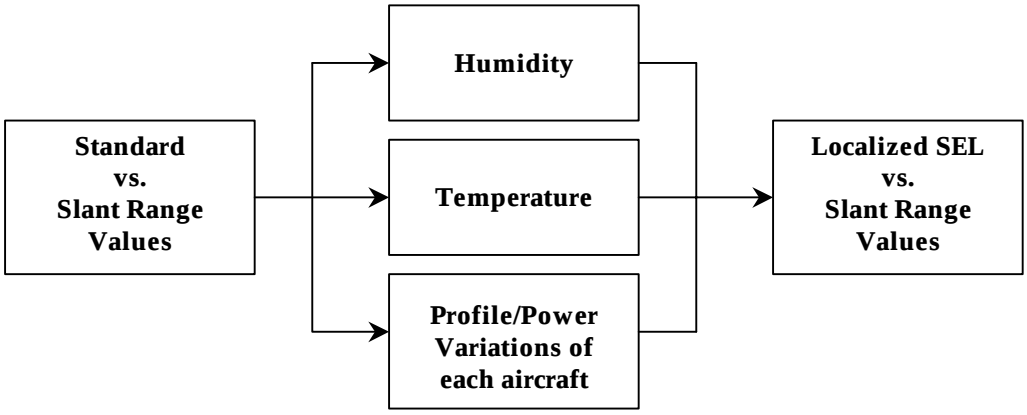
The single event noise descriptor used in the DNL system is the Sound Exposure Level (SEL). The SEL measure is an integration of DNL over the period of a single event such as an aircraft flyover, measured in dB.

Frequency, magnitude, and duration vary according to aircraft type, engine type, and power setting. Therefore, individual aircraft noise data are collected for various types of aircraft/engines at different power settings and phases of flight. Figure B-2 shows the relationship of the single event noise descriptor to the source sound energy.

SEL versus slant range values are derived from noise measurements made according to a source noise data acquisition plan developed by Bolt, Beranek, and Newman, Inc., in conjunction with the United States Air Force Armstrong Laboratory (AL) and carried out by AL. These standard day, sea level values form the basis for the individual event noise descriptors at any location and

are adjusted to the location by applying appropriate corrections for temperature, humidity, and variations from standard profiles and power settings of each aircraft.

Figure B-2. Sound Exposure Level



Ground-to-ground sound propagation characteristics are used for altitudes up to 500 feet with linear transition between 500 and 700 feet and air-to-ground propagation characteristics above 700 feet.

In addition to the assessment of aircraft flight operations, the DNL system incorporates noise resulting from engine/aircraft maintenance checks on the ground. Data concerning the orientation of the noise source, type of aircraft or engine, number of test runs on a typical day, power settings used and their duration, and use of suppression devices are collected for each ground run up or test position. This information is processed and the noise contribution added (on an energy summation basis) to the noise generated by flying operations to produce noise contours reflecting the overall noise environment with respect to aircraft air and ground operations.

APPENDIX C

APPENDIX C
DESCRIPTION OF THE NOISE MODELS

C.1 MR_NMAP

MR_NMAO (MOA Range NOISEMAP) is a general-purpose, PC-based computer program that calculates noise levels under Military Operating Areas (MOAs), Military Training Routes (MTRs), and the Ranges. These levels are output as contours or intabular format, and are suitable for inclusion in Environmental Impact Statements and Environmental Assessment. MROPS is a companion interface program that facilitates defining the airspace, specifying the aircraft types and operations, and controlling the computational features of MR_NMAP. MROPS and MR_NMAP, together with the contouring program NMPLOT, form a complete package for evaluating noise impacts under military airspaces.

The first module is MROPS. This is an interactive, Windows-based program which acts as the primary user interface. A series of menus and entry forms prompt the user for all required information. All data can be entered in tabular format. Geometric data such as airspace boundaries and flight tracks may alternatively be entered graphically using CAD-like features. The user may also draw upon databases which define all existing airspace components. This module manages data for various assessments and alternatives, and can be used to run the other modules.

MR_NMAP is the module which performs the noise calculations. It is a collection of building block noise models. All of the models are based on NOISEMAP technology, which embodies the physics of aircraft noise generation and propagation. Each model is structured so as to apply this technology to the way that aircraft fly in military airspace, and is optimized for the appropriate type of operation. From a modeling perspective, there are two main categories of aircraft operations: distributed operations, as are found in MOAs, and track operations, as are found on MTRs and target approaches. MR_NMAP is designed to accommodate additional and/or updated models as technology advances.

The third module, NMPLOT, is the Air Force=s standard noise contour plotting program. The user

will normally access NMPLOT through MROPS, but may interact with it directly to specify the layout of the graphical output.

C.2 MICROBNOISE

The US Army (USA) has developed the Environmental Noise Management Plan (ENMP) to safeguard the operational capability of Army Installations from encroachment by off-post, noise-sensitive land uses such as housing. ENMP requires noise contours to be developed around military installations to assist in effective land-use planning and to prevent community encroachment on high-noise training areas. The ENMP program uses the Blast Noise Prediction (MicroBNOISE) computer program developed by U.S. Army Construction Engineering research laboratory (USA-CERL) to generate noise contour maps that characterize an installation=s noise Afootprint.≅

MicroBNOISE is a series of digital computer programs that can produce C-weighted day/night average sound level (DDNL) contours for military activities or operations having impulsive noise sources (e.g., artillery, explosions or demolitions, and weapon blasts). The program does not differentiate between subsonic and supersonic rounds, nor does it account for the shockwave blast of a supersonic round. However, it does account for the directivity patterns and variable changes of the propellant blast.

Data required to use MicroBNOISE are as follows:

Base location B coordinates that identify the base boundary;

Firing points B firing point name and location;

Target points B target point name and location;

Activity data B combines firing point, target point, and weapon code with their internal indices, minimum and maximum charge weight, noise at target, and operational counts for day and night;

Meteorological data B provides a set of temperature inversion statistics to the program; and

Metric data B noise metric and assessment period.

Once the data is compiled, MicroBNOISE will produce noise contours for the affected area that can be used to assess aligning and scheduling of mission activities.

APPENDIX D

COMPUTER-GENERATED CONTOURING DATA

```
TITL
          1          0
METR
DECM
FLOT
          1
CASE
BNOISE 3.2M OUTPUT
LINC
FTDX
         21
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    38500.000000    26150.000000
    40000.000000    26000.000000
    40550.000000    25250.000000
    41500.000000    24900.000000
    44000.000000    24850.000000
    45900.000000    25100.000000
    47200.000000    24350.000000
    47250.000000    22750.000000
    50500.000000    23000.000000
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    47500.000000    33250.000000
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    40250.000000    31750.000000
    40050.000000    32150.000000
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    36900.000000    30300.000000
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LINC
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LINC
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LINC
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LINC
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LINC
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    40300.000000    25750.000000
    40050.000000    26000.000000
    39800.000000    25750.000000
LINC
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         5
    40000.000000    25650.000000
    40250.000000    26150.000000
    40500.000000    25650.000000
    40250.000000    25900.000000
    40000.000000    25650.000000
```

```
LINC
F25
          5
    41000.000000    25450.000000
    41250.000000    25950.000000
    41500.000000    25450.000000
    41250.000000    25700.000000
    41000.000000    25450.000000
LINC
F26
          5
    41100.000000    25450.000000
    41350.000000    25950.000000
    41600.000000    25450.000000
    41350.000000    25700.000000
    41100.000000    25450.000000
LINC
F27B
          5
    40950.000000    24550.000000
    41200.000000    25050.000000
    41450.000000    24550.000000
    41200.000000    24800.000000
    40950.000000    24550.000000
LINC
F27C
          5
    40750.000000    24150.000000
    41000.000000    24650.000000
    41250.000000    24150.000000
    41000.000000    24400.000000
    40750.000000    24150.000000
LINC
F29
          5
    41800.000000    25250.000000
    42050.000000    25750.000000
    42300.000000    25250.000000
    42050.000000    25500.000000
    41800.000000    25250.000000
LINC
F30A
          5
    42450.000000    25200.000000
    42700.000000    25700.000000
    42950.000000    25200.000000
    42700.000000    25450.000000
    42450.000000    25200.000000
LINC
F30B
          5
    42750.000000    25100.000000
    43000.000000    25600.000000
    43250.000000    25100.000000
    43000.000000    25350.000000
    42750.000000    25100.000000
LINC
F31
          5
    44000.000000    25000.000000
    44250.000000    25500.000000
    44500.000000    25000.000000
    44250.000000    25250.000000
    44000.000000    25000.000000
LINC
F33
          5
    44400.000000    25050.000000
    44650.000000    25550.000000
    44900.000000    25050.000000
    44650.000000    25300.000000
    44400.000000    25050.000000
LINC
F35
          5
    45200.000000    25100.000000
    45450.000000    25600.000000
    45700.000000    25100.000000
    45450.000000    25350.000000
    45200.000000    25100.000000
LINC
F37
          5
    45500.000000    25050.000000
    45750.000000    25550.000000
    46000.000000    25050.000000
    45750.000000    25300.000000
    45500.000000    25050.000000
LINC
F38
          5
    45950.000000    25200.000000
    46200.000000    25700.000000
    46450.000000    25200.000000
    46200.000000    25450.000000
    45950.000000    25200.000000
LINC
F39A
          5
    46775.000000    25750.000000
    47025.000000    26250.000000
    47275.000000    25750.000000
    47025.000000    26000.000000
    46775.000000    25750.000000
LINC
F47
          5
    48000.000000    27150.000000
    48250.000000    27650.000000
    48500.000000    27150.000000
    48250.000000    27400.000000
    48000.000000    27150.000000
```

```
LINC
F53
          5
    47950.000000    27900.000000
    48200.000000    28400.000000
    48450.000000    27900.000000
    48200.000000    28150.000000
    47950.000000    27900.000000
LINC
F55
          5
    47850.000000    28150.000000
    48100.000000    28650.000000
    48350.000000    28150.000000
    48100.000000    28400.000000
    47850.000000    28150.000000
LINC
F59C
          5
    46250.000000    28900.000000
    46500.000000    29400.000000
    46750.000000    28900.000000
    46500.000000    29150.000000
    46250.000000    28900.000000
LINC
F59D
          5
    46350.000000    29350.000000
    46600.000000    29850.000000
    46850.000000    29350.000000
    46600.000000    29600.000000
    46350.000000    29350.000000
LINC
F61
          5
    46350.000000    29800.000000
    46600.000000    30300.000000
    46850.000000    29800.000000
    46600.000000    30050.000000
    46350.000000    29800.000000
LINC
F63
          5
    46450.000000    30000.000000
    46700.000000    30500.000000
    46950.000000    30000.000000
    46700.000000    30250.000000
    46450.000000    30000.000000
LINC
F71
          5
    45450.000000    31000.000000
    45700.000000    31500.000000
    45950.000000    31000.000000
    45700.000000    31250.000000
    45450.000000    31000.000000
LINC
F85
          5
    45300.000000    32000.000000
    45550.000000    32500.000000
    45800.000000    32000.000000
    45550.000000    32250.000000
    45300.000000    32000.000000
LINC
AP6
          5
    48550.000000    24400.000000
    48800.000000    24900.000000
    49050.000000    24400.000000
    48800.000000    24650.000000
    48550.000000    24400.000000
LINC
AP7
          5
    48650.000000    24400.000000
    48900.000000    24900.000000
    49150.000000    24400.000000
    48900.000000    24650.000000
    48650.000000    24400.000000
LINC
AP8
          5
    49150.000000    24950.000000
    49400.000000    25450.000000
    49650.000000    24950.000000
    49400.000000    25200.000000
    49150.000000    24950.000000
LINC
AP9
          5
    49150.000000    24750.000000
    49400.000000    25250.000000
    49650.000000    24750.000000
    49400.000000    25000.000000
    49150.000000    24750.000000
LINC
AP13
          5
    48850.000000    24100.000000
    49100.000000    24600.000000
    49350.000000    24100.000000
    49100.000000    24350.000000
    48850.000000    24100.000000
LINC
T03
          5
    37783.330000    29433.330000
    37783.330000    29766.670000
    38116.670000    29433.330000
    38116.670000    29766.670000
    37783.330000    29433.330000
```

```
LINC
T03A
         5
    38583.330000    29283.330000
    38583.330000    29616.670000
    38916.670000    29283.330000
    38916.670000    29616.670000
    38583.330000    29283.330000
LINC
T06
         5
    38783.330000    30033.330000
    38783.330000    30366.670000
    39116.670000    30033.330000
    39116.670000    30366.670000
    38783.330000    30033.330000
LINC
T06A
         5
    38733.330000    29883.330000
    38733.330000    30216.670000
    39066.670000    29883.330000
    39066.670000    30216.670000
    38733.330000    29883.330000
LINC
T07
         5
    38683.330000    29733.330000
    38683.330000    30066.670000
    39016.670000    29733.330000
    39016.670000    30066.670000
    38683.330000    29733.330000
LINC
T08
         5
    38783.330000    29533.330000
    38783.330000    29866.670000
    39116.670000    29533.330000
    39116.670000    29866.670000
    38783.330000    29533.330000
LINC
T09
         5
    38583.330000    29383.330000
    38583.330000    29716.670000
    38916.670000    29383.330000
    38916.670000    29716.670000
    38583.330000    29383.330000
LINC
T10
         5
    38633.330000    29033.330000
    38633.330000    29366.670000
    38966.670000    29033.330000
    38966.670000    29366.670000
    38633.330000    29033.330000
LINC
T11
         5
    38733.330000    28633.330000
    38733.330000    28966.670000
    39066.670000    28633.330000
    39066.670000    28966.670000
    38733.330000    28633.330000
LINC
T12
         5
    37733.330000    28383.330000
    37733.330000    28716.670000
    38066.670000    28383.330000
    38066.670000    28716.670000
    37733.330000    28383.330000
LINC
T13
         5
    38083.330000    28133.330000
    38083.330000    28466.670000
    38416.670000    28133.330000
    38416.670000    28466.670000
    38083.330000    28133.330000
LINC
T14
         5
    38783.330000    27683.330000
    38783.330000    28016.670000
    39116.670000    27683.330000
    39116.670000    28016.670000
    38783.330000    27683.330000
LINC
T15
         5
    39033.330000    27233.330000
    39033.330000    27566.670000
    39366.670000    27233.330000
    39366.670000    27566.670000
    39033.330000    27233.330000
LINC
T16
         5
    39033.330000    26883.330000
    39033.330000    27216.670000
    39366.670000    26883.330000
    39366.670000    27216.670000
    39033.330000    26883.330000
LINC
T17
         5
    38933.330000    26683.330000
    38933.330000    27016.670000
    39266.670000    26683.330000
    39266.670000    27016.670000
    38933.330000    26683.330000
```

```
LINC
T18
         5
    38983.330000    26433.330000
    38983.330000    26766.670000
    39316.670000    26433.330000
    39316.670000    26766.670000
    38983.330000    26433.330000
LINC
T19
         5
    39083.330000    26233.330000
    39083.330000    26566.670000
    39416.670000    26233.330000
    39416.670000    26566.670000
    39083.330000    26233.330000
LINC
T20
         5
    39283.330000    26183.330000
    39283.330000    26516.670000
    39616.670000    26183.330000
    39616.670000    26516.670000
    39283.330000    26183.330000
LINC
T21
         5
    39483.330000    26233.330000
    39483.330000    26566.670000
    39816.670000    26233.330000
    39816.670000    26566.670000
    39483.330000    26233.330000
LINC
T22
         5
    39733.330000    26183.330000
    39733.330000    26516.670000
    40066.670000    26183.330000
    40066.670000    26516.670000
    39733.330000    26183.330000
LINC
T23
         5
    40033.330000    26033.330000
    40033.330000    26366.670000
    40366.670000    26033.330000
    40366.670000    26366.670000
    40033.330000    26033.330000
LINC
T24
         5
    40133.330000    25833.330000
    40133.330000    26166.670000
    40466.670000    25833.330000
    40466.670000    26166.670000
    40133.330000    25833.330000
LINC
T25
         5
    41083.330000    25683.330000
    41083.330000    26016.670000
    41416.670000    25683.330000
    41416.670000    26016.670000
    41083.330000    25683.330000
LINC
T26
         5
    41183.330000    25683.330000
    41183.330000    26016.670000
    41516.670000    25683.330000
    41516.670000    26016.670000
    41183.330000    25683.330000
LINC
T27B
         5
    41533.330000    25433.330000
    41533.330000    25766.670000
    41866.670000    25433.330000
    41866.670000    25766.670000
    41533.330000    25433.330000
LINC
T27C
         5
    41633.330000    25383.330000
    41633.330000    25716.670000
    41966.670000    25383.330000
    41966.670000    25716.670000
    41633.330000    25383.330000
LINC
T29
         5
    41883.330000    25533.330000
    41883.330000    25866.670000
    42216.670000    25533.330000
    42216.670000    25866.670000
    41883.330000    25533.330000
LINC
T30A
         5
    42683.330000    25583.330000
    42683.330000    25916.670000
    43016.670000    25583.330000
    43016.670000    25916.670000
    42683.330000    25583.330000
LINC
T30B
         5
    42933.330000    25483.330000
    42933.330000    25816.670000
    43266.670000    25483.330000
    43266.670000    25816.670000
    42933.330000    25483.330000
```

```
LINC
T31
         5
    43983.330000    25233.330000
    43983.330000    25566.670000
    44316.670000    25233.330000
    44316.670000    25566.670000
    43983.330000    25233.330000
LINC
T33
         5
    44433.330000    25333.330000
    44433.330000    25666.670000
    44766.670000    25333.330000
    44766.670000    25666.670000
    44433.330000    25333.330000
LINC
T35
         5
    45283.330000    25533.330000
    45283.330000    25866.670000
    45616.670000    25533.330000
    45616.670000    25866.670000
    45283.330000    25533.330000
LINC
T37
         5
    45583.330000    25333.330000
    45583.330000    25666.670000
    45916.670000    25333.330000
    45916.670000    25666.670000
    45583.330000    25333.330000
LINC
T38
         5
    45883.330000    25633.330000
    45883.330000    25966.670000
    46216.670000    25633.330000
    46216.670000    25966.670000
    45883.330000    25633.330000
LINC
T39A
         5
    46333.330000    25833.330000
    46333.330000    26166.670000
    46666.670000    25833.330000
    46666.670000    26166.670000
    46333.330000    25833.330000
LINC
T47
         5
    47833.330000    27283.330000
    47833.330000    27616.670000
    48166.670000    27283.330000
    48166.670000    27616.670000
    47833.330000    27283.330000
LINC
T53
         5
    47783.330000    27883.330000
    47783.330000    28216.670000
    48116.670000    27883.330000
    48116.670000    28216.670000
    47783.330000    27883.330000
LINC
T55
         5
    47783.330000    28183.330000
    47783.330000    28516.670000
    48116.670000    28183.330000
    48116.670000    28516.670000
    47783.330000    28183.330000
LINC
T59C
         5
    45333.330000    28783.330000
    45333.330000    29116.670000
    45666.670000    28783.330000
    45666.670000    29116.670000
    45333.330000    28783.330000
LINC
T59D
         5
    45983.330000    29383.330000
    45983.330000    29716.670000
    46316.670000    29383.330000
    46316.670000    29716.670000
    45983.330000    29383.330000
LINC
T61
         5
    44783.330000    29633.330000
    44783.330000    29966.670000
    45116.670000    29633.330000
    45116.670000    29966.670000
    44783.330000    29633.330000
LINC
T63
         5
    46333.330000    30083.330000
    46333.330000    30416.670000
    46666.670000    30083.330000
    46666.670000    30416.670000
    46333.330000    30083.330000
LINC
T71
         5
    45233.330000    31033.330000
    45233.330000    31366.670000
    45566.670000    31033.330000
    45566.670000    31366.670000
    45233.330000    31033.330000
```

```
LINC
T85                                                 36.63
          5
    44433.330000    30633.330000                    36.24
    44433.330000    30966.670000
    44766.670000    30633.330000                    35.90
    44766.670000    30966.670000
    44433.330000    30633.330000                    35.33
LINC
IMP                                                 34.62
          5
    43833.330000    28333.330000                    33.84
    43833.330000    28666.670000
    44166.670000    28333.330000                    31.84
    44166.670000    28666.670000
    43833.330000    28333.330000                    32.43
MTRC
CDNL                                                32.98
NINJ
         31          21                             33.90
DIDJ
     1000.000000     1000.000000                    34.91
XRYR
    27000.000000    17000.000000                    35.63
IRJR
        1.000000        1.000000                    36.35
GRID
                                                    37.11
  30.78
                                                    37.53
  31.39
                                                    37.92
  31.89
                                                    38.19
  32.49
                                                    38.48
  33.46
                                                    38.59
  34.40
                                                    38.41
  35.05
                                                    38.28
  35.57
                                                    38.20
  36.01
                                                    37.74
  36.34
                                                    37.22
  36.81
                                                    36.67
  37.04
                                                    35.93
  37.06
                                                    35.24
  37.07
                                                    32.50
  36.84
```

33.45	40.46
34.38	40.77
35.36	40.95
36.42	41.23
37.19	41.20
37.87	40.94
38.37	40.59
38.86	40.26
39.22	39.79
39.53	39.16
39.74	38.58
39.74	37.88
39.78	34.63
39.69	36.04
39.37	36.88
39.08	37.81
38.65	38.55
38.02	39.41
37.44	39.99
36.59	40.64
33.55	41.19
34.69	41.89
35.78	42.29
36.84	42.59
37.53	42.75
38.30	42.69
38.88	42.49
39.47	42.19
40.05	41.69

40.94	40.52
40.32	41.31
39.49	42.18
38.93	43.11
35.91	43.84
37.08	44.30
37.93	44.67
38.73	45.08
39.58	45.19
40.25	45.13
41.11	45.04
41.82	44.61
42.59	44.13
43.18	43.52
43.61	42.78
43.86	41.79
43.97	40.79
43.94	37.63
43.76	38.61
43.45	39.52
43.01	40.49
42.41	41.34
41.57	42.22
40.68	43.49
39.78	44.31
36.86	45.13
37.79	45.73
38.76	46.18
39.64	46.41

46.58	42.62
46.55	38.81
46.27	40.00
45.75	41.82
45.20	43.14
44.47	44.21
43.74	45.56
42.88	46.37
41.63	47.14
38.35	47.89
39.32	48.57
40.19	49.04
41.28	49.62
42.82	50.49
43.96	50.47
45.03	49.34
45.82	48.37
46.62	47.45
47.16	46.32
47.65	45.40
48.10	44.42
48.20	43.40
48.08	39.43
47.64	41.49
47.05	43.16
46.33	44.54
45.44	45.63
44.56	46.75
43.72	47.58

48.32	52.61
49.10	49.37
49.72	48.18
50.50	46.71
53.13	45.57
56.33	44.52
56.67	42.35
53.73	44.05
50.08	45.46
48.51	46.79
47.26	48.03
46.07	49.11
45.05	49.81
44.03	50.60
40.99	51.29
42.80	51.81
44.47	53.54
45.52	58.98
46.92	70.30
47.87	79.80
48.84	61.13
49.51	53.88
50.27	50.16
50.83	48.85
52.43	47.52
57.51	46.10
64.58	44.97
65.64	43.31
59.04	45.08

46.46	54.83
47.88	55.22
48.91	56.18
50.07	56.13
50.94	54.48
51.63	52.64
52.41	51.40
53.03	50.08
53.80	48.64
56.78	47.04
61.32	45.59
62.29	44.76
57.98	46.65
53.14	48.08
50.78	49.40
49.53	50.70
48.00	52.02
46.67	53.02
45.27	54.88
44.12	58.59
45.85	60.70
47.33	57.70
48.57	57.49
49.86	57.18
50.93	55.63
51.97	54.08
53.05	53.03
54.44	51.86
55.19	50.52

49.06	53.59
47.50	54.83
45.94	57.76
45.50	61.74
47.32	63.31
48.78	62.60
50.27	71.84
51.71	71.88
52.72	61.92
54.05	60.64
56.18	56.31
62.33	53.27
73.15	51.15
60.24	49.69
63.01	47.93
62.90	46.14
58.49	46.65
55.71	48.61
53.99	50.14
52.49	51.65
50.93	53.05
49.36	54.44
47.83	56.47
46.18	62.27
45.93	68.62
48.04	71.31
49.66	67.21
51.03	65.59
52.30	70.24

71.43	47.21
68.47	49.17
62.11	50.64
54.26	52.35
51.38	53.79
49.58	55.51
47.80	58.67
46.17	65.60
47.11	71.92
49.06	74.22
50.59	67.24
52.12	61.22
53.65	61.45
55.23	61.45
58.71	57.42
66.42	54.87
77.84	52.47
90.45	50.51
70.44	48.83
64.59	47.22
70.70	45.72
68.61	47.16
64.30	49.07
59.68	50.51
53.87	52.05
51.19	53.58
49.36	55.05
47.59	56.72
45.95	60.90

64.02	50.25
63.62	48.84
60.61	47.46
57.16	46.11
56.52	44.74
55.75	46.07
54.21	47.85
52.71	49.33
51.19	50.45
49.75	51.65
48.25	52.63
46.72	53.59
45.13	55.51
46.69	58.35
48.69	56.11
49.93	54.28
51.48	53.46
52.86	52.84
53.96	52.24
55.45	51.37
62.32	50.16
68.33	49.32
59.52	48.04
55.87	46.71
54.88	45.33
54.27	43.92
53.47	44.81
52.46	46.56
51.42	48.37

49.44	50.62
50.31	50.19
51.06	49.65
51.92	48.96
52.59	48.23
53.12	47.14
52.97	45.84
52.44	44.69
52.08	43.35
51.59	41.64
50.87	41.14
50.03	43.46
49.27	44.94
48.23	46.22
47.12	47.35
45.85	48.17
44.49	48.61
42.68	48.96
43.28	49.36
45.17	49.43
46.70	49.36
48.18	49.23
49.06	48.85
49.70	48.37
50.23	47.59
50.74	46.82
50.96	45.84
51.15	44.78
50.89	43.44

41.90	45.31
40.82	45.77
39.80	46.17
41.24	46.29
42.93	46.12
44.21	46.19
45.26	45.72
45.96	45.04
46.78	44.73
47.46	43.63
47.79	42.85
47.96	41.78
47.86	40.45
47.70	39.91
47.48	39.25
46.93	36.15
46.20	37.05
45.35	39.29
44.46	40.68
43.11	41.88
42.09	42.69
40.72	43.59
39.99	44.09
37.04	44.25
39.85	44.38
41.25	44.48
42.55	44.26
43.55	44.00
44.38	43.69

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  42.78
  41.95
  40.81
  40.03
  39.50
  38.98
  38.38
  35.33
  36.16
  36.73
  38.21
  39.46
  40.84
  41.54
  41.74
  42.34
  42.50
  42.53
  42.31
  41.97
  41.49
  41.01
  39.71
  39.40
  39.03
  38.64
  38.02
  37.54
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